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BRIEFLY TOLD.

THE EDUCATIONAL FUND IS GROWING.—Last week we reported the fact that the fund that is being raised to properly carry on the educational work in which the American Gas Light Association is engaged amounted to $3,468 per annum for and through the 5-year period. Since that time the following additional subscriptions have been received:

Subscriber.	Total Amount Pledged.	Amount per Year Through 5-Year Period.
Dieterich, C. F., New York City	$100	$20
Lockport (N. Y.) Gas and Electric Light Co	50	10
Westmoreland Coal Co., Phila., Pa	500	100

These subscriptions bring the total sum pledged over the 5-year period up to the handsome total of $3,598, and it is our further agreeable task to say that the named sum is more than likely to be increased during the week in sensible measure.

NOTES.—The Directors of the Cincinnati Gas Light and Coke Company have issued a call for a shareholders' meeting, to be held December 21st, for the purpose of voting on a proposition to increase the capital stock of the Company from $8,500,000 to $9,000,000. General Hickenlooper is thus quoted respecting the matter: "The money is needed for extensions and ordinary improvements. It has always been our custom, as the city grew and we were compelled to extend our system, to raise the money for the expenditures by issuing new stock. Such a new issue is due now, and it is for only $500,000. When the increase has been ratified by the stockholders all those of record will be allowed to subscribe for the new stock, at the ratio of about one share for every 20 held. There will be no scrip, the Company buying all fractional shares."——The Board of Arbitration named to determine the value of the Covington (Ky.) Gas Light Company's plant and franchise, which proceeding was instituted by the authorities under a peculiar provision of the Company's charter, have presented their report. The sum named by the Board as their valuing is $486,000, which includes $36,000 as the value of the franchise for the four years of life remaining to it under the original agreement between the Company and the city. Next week we will give a complete *resume* of this celebrated case.——The Philadelphia *Times* says that the entire property of the new Consolidated Gas Company, of Newark, N. J., which is capitalized in $15,000,000, has been transferred, under a lease of 999 years, to the United Gas Improvement Company, of Philadelphia. This lease will be assigned by the latter to a new Company, to be organized under the laws of New Jersey, probably with the title of the Essex and Union Gas Company. The United Gas Improvement Company will assume all the rights and liabilities of the Essex Company under the terms of the lease. The Improvement Company for the first six years will be directly responsible for all payments required by that contract. These include all operating and maintenance expenses, all taxes, interest and other fixed charges of every description, and after January 1, 1900, in semi-annual instalments (payments to begin July 1, 1900), cash available for dividends on the $6,000,000 stock of the Newark Consolidated Company,

beginning at ½ per cent., and increasing by ½ per cent. each year until it reaches 5 per cent. in 1909. Thereafter $300,000 (5 per cent. yearly) will be paid to the end of the lease.——A mortgage bond amounting to $500,000 has been placed by the McKeesport (Pa.) Gas Improvement Company with the Guaranty Trust Company, of New York. The Pittsburg *Despatch*, in chronicling the matter, says that the placing of the mortgage and its recording were simply business concerns of the McKeesport Company and of the United Coke and Gas Company, of Glassport, Pa.——Present indications are that the borough of Tyrone, Pa., will speedily acquire the properties of the Tyrone Gas and Water Company. The negotiations on this account have been diplomatically conducted, provided delay means diplomacy.

THE BEAL MEDAL AWARDED TO MR. HENRY L. DOHERTY.—At the Old Point Comfort meeting (Oct., 1897), of the American Gas Light Association, the report of the Council revealed the fact that Mr. Wm. R. Beal, President of the Central Union Gas Light Company, of this city, had offered to present annually a gold medal, which was to be awarded by the Association to the writer of the most valuable paper presented at each meeting. The Council having accepted the offer, suggested that the token be known as the Beal Medal, and that the decision as to the author entitled each year to receive it should be made "by a committee of three appointed by the President from among the Past-Presidents." The report of the Council was adopted, consequently the contributors of papers for the Niagara Falls meeting (Oct., 1898), became competitors for the honor of securing the medal. President Crockett, acting under the procedure prescribed, appointed as the Committee to make the award Mr. Malcolm S. Greenough, Capt. W. Henry White and Mr. Arthur E. Boardman. After due and thorough consideration the Committee unanimously declared in favor of the paper "How Can We Make the Use of Gas for Cooking More Universal?" which was prepared and read by Mr. Henry L. Doherty, General Manager of the Madison (Wis.) Gas and Electric Company. The medal

(the faces of which are shown in the accompanying illustrations) is of solid, fine gold, and it was designed and completed by Tiffany & Co., of New York. To say that it is artistic and handsome would be like attempting to improve the gold in the medal itself by gilding it, for the illustrations speak eloquently for the taste of the designer and for the skill of the smith. We congratulate Mr. Doherty on his successful essay for the first Beal Medal, and hope that its generous donor will for many a year be obliged to hold out the golden token as an incentive to the paper writers of the future.

[Communicated Article.]

The Acetylene Installation for Lighting the City of Wabash, Ind.

Wabash, Indiana, is a city of 12,500 inhabitants, which is at present lighted with natural gas, burned in Welsbach burners, and by an artificial oil gas made in the city and consumed in open flames, and also in Welsbachs.

The acetylene plant is to replace the artificial gas system, and will use the latter's mains, building, holder, etc. The present system is a branch of the Logansport and Wabash Valley Gas Company, of which Messrs. Chas. F. Dieterich and A. B. Proal, of 45 Broadway, New York, are, respectively, President and Secretary and Treasurer.

The oil gas plant at present in operation was installed in 1879, and now has 8½ miles of mains, mostly 3-inch and 4-inch, although there is about one mile of 6-inch, with a little 8-inch pipe near the station.

The Company has 192 meters and about 3,000 burners. It uses natural gas for fuel, and distils a pure, rich oil gas, of 65-candle power, from naphtha. This is stored in a 6,000-foot holder, and the daily output is from 4,000 to 6,000 cubic feet. The price of this gas varies, according to a sliding scale, from $2.50 to $3.70 per 1,000, according to the quantity used.

The acetylene installation to replace this plant is being installed by Mr. J. M. Morehead, of 157 Michigan avenue, Chicago, and consists of a Williamson improved generator, "type C," manufactured by the Sprague Machine Works. The generator, which is on the "wet" principle, consists of an upright shell of ⅜-inch boiler iron, 42 inches internal diameter by 8 feet 6 inches high, and terminates in a hopper, at the bottom of which is attached a 6 inch gate valve for withdrawing the residue.

The generator stands on four cast iron legs, and the over-all height is 10 feet 6 inches. The generator is arranged to be filled half way of its height with water and a siphon is provided to maintain the water at this level. In the upper part of the shell above the water is riveted an iron hopper, capable of holding the contents of a large iron drum of carbide—11 cwt. This hopper terminates on a screw conveyor, which is connected by means of a shaft through a stuffing box to water motor held on a bracket outside. The water connection is made to the generator through motor, whose exhaust is connected to the inside of the shell. It requires but very little more water to operate the motor than the amount necessary to form acetylene with the carbide introduced by its movement. The excess of water, if any, is discharged through the siphon automatically. If there is not sufficient water, and for cleaning the machine, a by-pass is arranged.

The water motor, which is brass lined throughout, and was built from designs of Mr. John Zander, Superintendent of the Sprague Machine Works, is on the principle of a duplex pump. It requires at least 7½ pounds of water pressure to operate it and make 10 revolutions per minute.

The carbide is elevated to the top of the generator by a chain-block, and the entire content of a drum (11 cwt.) is introduced through a charging door on top. After the charge is introduced and the door made tight the motor is started and the carbide is slowly conveyed by the screw operated by the motor to a point where it drops into the water under the screw.

As the mass of water into which the carbide falls is 42 inches in diameter and 4 feet deep, and as the carbide immediately sinks to the bottom and is virtually water jacketed, during the evolution of the gas no appreciable rise of temperature is possible. These machines are designed for town lighting and for large installations, and have a capacity of 2,500 cubic feet of acetylene every hour of the 24, which includes the time of filling and cleaning out; the latter operation can be carried out during the time that the machine is at work. When working at half this capacity, with the exhaust water from the pump at 40° F., the maximum heat was 84° F. The generator is provided with water glass, safety valve, etc., and was tested to 60 pounds per square inch, cold water.

The plant at Wabash will use second grade carbide from the Niagara works. A small percentage of this is unavoidable with the present processes, and a very advantageous price has been secured upon the yield of gas.

The generator is connected by 4-inch pipe to a relief holder of 200 cubic feet capacity, thence to the station meter and to the large holder.

At the present time the meter is connected direct to a part of the street mains, the balance being supplied by the large holder with oil gas. All of Canal street is now supplied with acetylene. This included 31 of the principal stores, which have in all 212 burners. As fast as the

other houses in the city can be tested and made tight and the burners replaced, they are being changed from oil gas to acetylene. Thirty days will suffice to change the entire city, when the oil gas plant will be abandoned, the benches torn out and the 6,000-foot holder used for acetylene.

Seven-tenths, five-tenths and 1-foot burners, made by the Stromm Mfg. Company, of Chicago, and by the Star Acetylene Burner Company, of Chattanooga, are being used.

The gas is sold by meter, "16-candle power hours" being the unit instead of 1 cubic foot, as the volume of gas sold is so very much smaller than that usually sold that confusion would arise if the old standard were adhered to.

This is the first installation where acetylene is piped through the streets and sold by meter, and thus far is a perfect success.

A duplicate of this plant will be installed early in December to light the town of Millbrook, Dutchess county, New York.

New Experiments on the Quantitative Synthesis of Water.

By Mr. Edward H. Keiser, in *Am. Chem. Jour.*

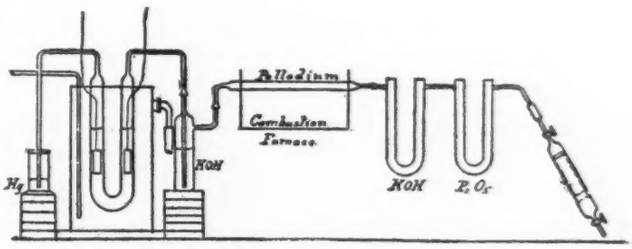
In the complete syntheses of water made in recent years for the purpose of determining the relative atomic weights of oxygen and hydrogen, the apparatus has been so constructed that the hydrogen was burnt at a jet in an atmosphere of oxygen. When the gases are combined in this way it is found that towards the end of the experiment it is difficult to keep up the combustion, the flame gradually dies out, and finally a residual gas remains in the combustion chamber, consisting of unburnt hydrogen and oxygen and whatever impurities were present in these gases. This residual gas volume must then be pumped out, measured and subjected to eudiometric gas analysis. From the volumes of hydrogen and oxygen thus found the weights of these gases that have remained uncombined must be calculated, and these weights must be deducted from the weights of oxygen and hydrogen found by direct weighing. The final weight of each gas is, therefore, not the result of weighings with the balance, but is dependent upon the accuracy of a volumetric gas analysis involving a number of eudiometric operations and calculations.

With the hope of making a complete quantitative synthesis of water in such a way that the weights of hydrogen, oxygen and water could be directly determined with the balance, the method described below was devised. It is based upon the fact that hydrogen when occluded in palladium is completely oxidized to water when the palladium hydride is brought in contact with an excess of oxygen.

In outline the steps of the process are as follows: First, a glass vessel with two communicating compartments, one of which is filled with phosphorus pentoxide, is exhausted with an air pump and weighed. Second, metallic palladium is put into the second compartment, and after exhausting the weight is again determined. Third, pure hydrogen is now admitted, and after the palladium is saturated the vessel is again connected with the air pump and a portion of the gas is pumped out and again weighed. The difference between the second and third weighings gives the weight of hydrogen to be oxidized. Fourth, pure oxygen is now slowly admitted, water is formed, and the vessel becomes warm. By regulating the current of oxygen the temperature can be kept down so that it does not rise much above that of surrounding objects. Finally, after all the hydrogen is oxidized and the vessel is full of oxygen, the excess of oxygen is pumped out, the gas, however, in going out is made to pass through the phosphorus pentoxide, so that all water is retained. The vacuous vessel is again weighed. The difference between the third and fourth weighings gives the weight of oxygen that has united with the hydrogen. Fifth, after the palladium has stood in the vacuum over the phosphorus pentoxide and the water has united with the pentoxide, the palladium is removed, and the vessel after exhausting is weighed. The difference between the first and fifth weighings gives the weight of water formed. This weight must agree closely with the sum of the weights of hydrogen and oxygen as previously found, if the experiment is to be regarded as trustworthy.

Fig. 1 shows the construction of the vessel that was used. It consisted of a wide glass tube 5½ cm. in diameter, 19 cm. in length; it was drawn down and closed at the bottom by a narrow tube carrying a glass stopcock, and at the top by a cap with a three-way stopcock. The cap was connected with the tube by means of a ground glass joint. The wide tube was constricted as shown in the figure, so as to form two compartments. The lower one served to hold the phosphorus pentoxide, the upper one the palladium. The palladium in the form of sponge was placed in the glass tube shown in Fig. 2. This tube was of such diameter that it could be easily placed inside of the larger tube after the cap had been removed. The constriction prevented it from touching the pentoxide. The dotted lines in Fig. 1 are intended to show the palladium tube in position.

Three tubes of the kind represented in Fig. 1 were made of the same kind of glass and of as nearly equal dimensions as possible. The volume of each was determined by hydrostatic weighing. The volumes of the smaller ones were made as nearly equal as possible to that of the larger one by adding compensating bulbs. Two of the tubes served as counterpoises to the working tube, one to counterpoise it for the first and fifth weighings, when the working tube contained no palladium, the other for the second, third and fourth weighings, when both palladium and pentoxide were present. Lead in the form of shot was put into the counterpoise tubes until they were somewhat heavier than the working tube. In all the weighings it was, therefore, necessary to add to the scale-pan carrying the working tube but few weights, and these were of small value. The correction of the weights for air displaced was very small, and as the weights of hydrogen and oxygen were not large, the reduction of these weights to a vacuum only affected the ratio in the fourth decimal place, which was within the limits of experimental error.



A Troemner balance with aluminum beam, having a capacity of 250 grams on each scale pan, was used. The method of weighing by reversals was used in all the determinations. With the working tube and the weights on one side, the counterpoise on the other, the fractions of milligrams were found by means of the vibrations and the sensibility. Then the loads were reversed and the weight found in the same way. The mean of the values was taken as the result of one weighing. At intervals of twelve hours the weighing was repeated. If there had been any appreciable leakage of air into the tube, it would have been possible to detect it in this way. The final value for a weight was thus the result of at least two, and in some cases of three and four double weighings made at intervals of 12 hours.

A Toepler mercury air-pump, without stopcocks, was used in making the exhaustions. Connected with the pump was a phosphorus pentoxide U-tube. The pentoxide that was used in the working tube was purified by subliming the commercial oxide in a stream of dry air. To prevent the pentoxide from falling into the narrow glass tube at the bottom of the working tube, a small spiral of platinum gauze was put into the narrow tube, and a loose plug of previously ignited asbestos was placed on top of the gauze. The pentoxide filled the lower compartment to within 3 millimeters of the constriction, and in quantity was largely in excess of the amount required to unite with the water formed. The palladium sponge was in the form of cohering masses, obtained by the reduction of pure pallad-ammonium chloride in a stream of hydrogen. It was free from ammonium chloride. The tube for holding the metal was open at the top, and was provided with a number of small holes near the bottom, the object of which was to facilitate the passage of the aqueous vapor from the palladium to the phosphorus pentoxide. The palladium tube when not in the working tube was kept in a desiccator over phosphorus pentoxide.

After putting the pentoxide into the working tube, exhausting and weighing it, air, dried over pentoxide, was slowly admitted. The cap was then removed and the palladium tube put into position, and the cap again instantly replaced. The tube was again exhausted and weighed. Thereupon it was charged with hydrogen. For this purpose it was connected by means of the 3 way cock with an apparatus furnishing a stream of purified electrolytic hydrogen. This apparatus is shown in Fig. 3. The U-tube with electrodes for decomposing dilute sulphuric acid, is shown on the left. It was kept cool by means of cold water flowing in the outer cylinder. The electrolytic hydrogen passed first through a concentrated solution of caustic potash, then over palladium sponge contained in a combustion tube. The metal in the middle of the combustion tube was kept at a dull red heat; that at the ends was

only slightly above the ordinary temperature. This palladium served to remove any oxygen that may have been present in the hydrogen. Other substances that might have been taken up by the palladium in the working tube would also have been removed. Thereupon the gas passed through U-tubes containing freshly fused caustic potash and resublimed phosphorus pentoxide. After the current of hydrogen had been running for about an hour and escaping at the 3-way cock, it was slowly admitted to the palladium. The electrolytic oxygen escaped through the mercury shown on the extreme left. By raising or lowering the columy of mercury, the pressure in the interior of the apparatus could be easily regulated.

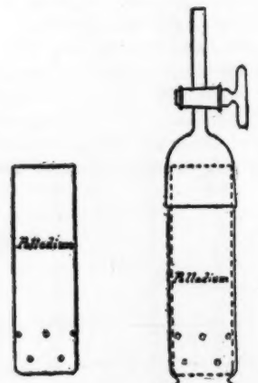


Fig. 2.

Fig. 1.

After the palladium was saturated the working tube was connected with the air-pump, and about a liter and a half of gas was pumped out. Gas not taken up by the palladium was thus removed. After weighing, the tube was again attached to the electrolytic apparatus, which now, with reversed current, was furnishing a stream of pure dry oxygen. The oxygen was also passed over hot palladium to remove hydrogen and any other substances that might possibly be present and capable of uniting with the metal. The oxygen was dried with fused caustic potash and phosphorus pentoxide. After the oxygen had been flowing through the apparatus for about an hour and escaping at the 3-way cock, the latter was cautiously opened so as to admit a very slow stream of gas. Moisture was at once deposited on the walls of the tube. If at this point a rapid stream of oxygen be admitted, the palladium at its upper surface can be seen to glow. This, however, was avoided in all the quantitative experiments recorded below. By admitting the oxygen slowly the temperature of the working tube was not allowed to rise much above that of the surrounding air. From 4 to 5 hours were required to oxidize the hydrogen. Finally, when the tube was full of oxygen, it was allowed to stand over night. During this time most of the water combined with the pentoxide. Then the lower stopcock was connected with the pump, and the excess of oxygen withdrawn. This excess of oxygen in passing out went through the pentoxide, so that no miosture was removed from the tube in this way. The exhausted tube was weighed, and, after the palladium had been standing over the pentoxide in the vacuum for at least 48 hours, dry air was admitted, the palladium removed, and after again exhausting the tube was weighed. This last weighing, taken in connection with the first, gave directly the amount of water taken up by the pentoxide.

To give an idea of the details of calculation, the complete data of the second experiment are here given.

1st Weighing. Tube plus P_2O_5 plus Weights against Tare No. 1.	2d Weighing. Tube plus P_2O_5 plus Pd plus Weights against Tare No. 2.	3d Weighing. Tube plus P_2O_5 plus PdH plus Weights against Tare No. 2.	4th Weighing. Tube plus P_2O_5 plus Pd plus H plus O plus Weights against Tare No. 2.	5th Weighing. Tube plus P_2O_5 plus H_2O plus Weights against Tare No. 1.
3.92084	3.67523	3.39591	1.17682	1.42185
3.92124	3.67538	3.39598	1.17714	1.42178
3.92104	3.67530	3.39594	1.17698	1.42181

Weight of hydrogen = 3.67530 — 3.39594 = 0.27936
Weight of oxygen = 3.39594 — 1.17698 = 2.21896

Weight of hydrogen + oxygen = 2.49832
Weight of water = 3.92104 — 1.42181 = 2.49923

Difference 0.00091

Ratio of hydrogen to oxygen = 0.27936 : 2.21896 = 1 : 7.943
Ratio of hydrogen to water = 0.27936 : 2.49923 = 1 : 8.946

Reducing the weights to a vacuum has no appreciable effect upon the ratio. Thus reduced weight of hydrogen = 0.27936 + 0.00002 = 0.27938. Reduced weight of oxygen = 2.21896 + 0.00030 = 2.21926. Ratio H : O = 1 : 7.943. Reduced weight of water = 2.49923 + 0.00032 = 2.49955. Ratio of H : H_2O = 1 : 8.946.

Altogether six determinations were attempted, two of these gave results that showed that there was either leakage or imperfect drying of the gases, because the direct weight of water in one of these exceeded the sum of the weights of hydrogen and oxygen by 6 milligrams, and in the other case by 4.5 milligrams. These have accordingly been rejected. The results obtained from the others are as follows:

No.	Wt. of H.	Wt. of O.	Sum of H + O.	Wt. of H_2O Found.	Difference.
1	0.27549	2.18249	2.45798	2.45975	0.00177
2	0.27936	2.21896	2.49832	2.49923	0.00091
3	0.27091	2.15077	2.42168	2.42355	0.00187
4	0.26845	2.13270	2.40115	2.40269	0.00154

Calculating the ratio of oxygen to 1 part of hydrogen from the second and third columns, we have:

No.	Ratio.
1	7.922
2	7.943
3	7.939
4	7.944
Mean	7.937

If the weights are reduced to a vacuum, the ratios become:

No.	Ratio.
1	7.923
2	7.943
3	7.940
4	7.945
Mean	7.937+

From the second and fifth columns we obtain the ratio of water to 1 part of hydrogen.

No.	Ratio.
1	8.929
2	8.946
3	8.946
4	8.950
Mean	8.943

The first ratio gives, for the atomic weight of oxygen, the number 15 874, the last one 15.886. The mean of the two is 15.880.

The Ross-Gibson Furnace for Heating Rivets.

Mr. G. Lestang (*Revue Industrielle*) describes a new design of furnace for heating rivets, which apparatus is being put upon the market by Messrs. Ross & Gibson, London, England. According to the illustration, the furnace is shown, communication with the combustion chamber being effected by means of suitable passages. This chamber forms a sort of hopper surmounted by a chimney nearly 20 feet high above the grate. The hopper or holder is filled with rivets through a door hung at the top. When the proper temperature is reached they are drawn out of the chamber through the opening *t*, placed at the bottom of the door.

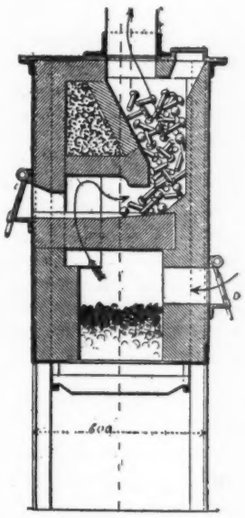
The flames given off at the fire are drawn by the high chimney through the mass of rivets, forming a column some 8½ to 10 inches high; when they arrive at the bottom of the column they are ready for use, while those at the top are nearly cold, providing the working and charging of the heater have been properly attended to regularly.

The heat of the flame is absorbed very rapidly by the rivets, and each one descends gradually by gravity to the bottom of the holder and with the temperature requisite for riveting.

This method of progressive heating is economical and rapid. While the fireplace shown measures only 2 by 2 feet, with a height of 5 feet, it is capable of heating, in 1 day of 9 hours, 3,000 three quarter inch

rivets, with a consumption of 220 pounds of coal, instead of the 660 to 1,100 pounds burnt in the ordinary heaters.

Air is admitted through a regulator in the fire door *D*, in such quantities as deemed necessary to insure a perfect combustion of the gases



formed before they reach the rivets. In addition, the combustion chamber is large enough to allow the complete mixture of these gases with the air. If the work is carried on under normal conditions no smoke is produced. It can be easily regulated in proportion as required by the work to be performed.

When rivets of different lengths are to be heated they are charged in layers. Their descent then preserves the proper order. Special rivets may be introduced directly into the combustion chamber by means of the door.

Portable Pneumatic Riveters.

Engineering Record says that experiments with air riveters have been in progress in the yards of the Chicago Shipbuilding Company for the past three years, and at the recent meeting of the Society of Naval Architects and Marine Engineers, Mr. W. I. Babcock, Manager of the Company, presented a paper reviewing the progress made. A horizontal stationary steam riveter, with 5-foot reach, was in use when the experiments were begun. This could drive 1,800 rivets in 10 hours, at a cost of half a cent each. Compressed air was selected for the motive power of the portable machines, as it was not subject to freezing, and for the reason that a compressor plant was necessary for the pneumatic hammers, drills, reamers and calkers. In 1896 two compression bow machines were installed. One weighed 2,500 pounds, and had a reach of 72 inches; the other weighed 1,700 pounds and had a reach of 45 inches, but both were found too heavy for economical use. Pneumatic calking hammers were used in 1896 to drive rivets, and worked well when the rivet was held on by a cup fitted to the head of a pneumatic piston. Soon the hammer and holding on cylinders were connected by a light horseshoe frame, so as to make one machine, with a wrought iron pipe frame so light that a machine with a 9-inch reach weighs only 83 pounds, a 51½-inch machine 160 pounds, and a 70 inch machine 220 pounds. The smaller machines are usually moved by hand, but they may be suspended by a differential hoist from a trolley running on an I-beam supported by two A-frames. These machines are very satisfactory, upset the rivet better, and drive it hotter than is done by hand. For decks and tank tops, where the rivets are put up from below, and the action of the hammer is always vertically downward, a simple counterweighted arrangement of the hammer mounted on a bent pipe, as if on a wheelbarrow with two wheels, is used. The pipe is bent in the shape of a letter U, which is in a vertical plane with the two legs normally nearly horizontal. The lower leg is much shorter than the upper one, carries the pneumatic vertical hammer at its extremity, and is mounted on the transverse horizontal axis at about the middle of its length. The end of the long upper leg of the frame has a transverse handle-bar. The operator raises the handle end sufficiently to get the die over the point of the rivet, and then bears down as the air is turned on. A second man with a chipping hammer cuts off the surplus metal, and a few seconds' work of the riveter again suffices to complete a very satisfactory operation. A pneumatic holder-on is used below, and three men and a heater boy will drive from 800 to 1,000 rivets in a day.

For driving countersunk rivets a die was used which formed a small teat on the head of the rivet. This teat served to center and hold a milling tool which cut off the surplus metal flush with the surface of the plate, after which the teat was cut off with a cold chisel. This method was abandoned on account of the difficulty of getting a satisfactory milling tool, and countersunk rivets are now finished by hand chipping. They are driven by a pneumatic hammer mounted in gimbals and attached to the wheeled U-frame, or to a trolley running in a slotted pipe which may be suspended, jacked or clamped in almost any required position. In all cases the pneumatic holder on is used against the inside rivet head, and can be easily braced or secured by hook bolts or other methods, a simple one being to arrange a horizontal counter balanced board to slide vertically against two movable 6 by 6 inch studs about 8 feet apart.

Mr. Babcock concludes by state that "the unanimous opinion of the hull inspectors who have been on duty in our yard for two years and more is that the rivets are first-class in every respect, and make far better and tighter work than those driven by hand. As for the cost, I will say that, adding cost of air, repairs, etc., the saving is from 1 to 2 cents per rivet over piecework prices for hand riveting, depending upon the location in the ship and averaging about 1½ cents. In an ordinary lake steamer of 4,000 tons the saving is from $4,000 to $5,000 over hand work."

Electric Power and its Application on the 3-Phase System to the Bristol Wagon and Carriage Works.[1]

While there have been several papers read in this country before engineering societies on the application of electric power in works, yet this subject does not appear to have been brought prominently before the members of the British Association.

It is presumably one of the purposes of this Association that man generally shall procure the greatest possible service from the sources of energy placed by nature at his disposal, and that the subjects of this realm shall be in the van of progress in attaining this object; while it is well known that the waste of energy by the uneconomical use of coal is enormous, more especially in this country.

Lord Armstrong, in his address to this Association at Newcastle, in 1863, said that "the greatness of England much depends upon the superiority of her coal, in cheapness and in quality over that of other nations; but we have already drawn, from our choicest mines, a far larger quantity of coal than has been raised in all other parts of the world put together; and the time is not remote when we shall have to encounter the disadvantages of increased cost of working and diminished value of produce." He then proceeded to explain that the total amount of workable coal in this country was calculated to be about 80,000 million tons, which, allowing for the then rate of increase of 2¾ million tons per annum, would only last 212 years. He further stated that "long before complete exhaustion takes place, England will have ceased to be a coal-producing country on an extensive scale. The ultimate results will be to render labor so abundant in the United States that our iron manufacturers will be underbid by the unrivalled iron and coal resources of Pennsylvania. The question is, not how long our coal will endure before complete exhaustion is effected, but how long will those particular coal seams last, which yield coal of a quality and at a price to enable this country to maintain her present supremacy in manufacturing?" Are we not already about to realize by experience what Lord Armstrong prophesied a third of a century ago? It is the case that many large collieries have already been closed because the expense of working prevented their competing. It is also the fact that foreign firms can already deliver in this country manufactured iron at lower prices than we can supply it, notwithstanding their disadvantage in shipping rates. Within the past few weeks, for example, the Corporation of Glasgow itself obtained tenders for a large quantity of cast iron pipes, when it was found that tenders from the United States were lower than any of their local firms.

In the year 1895 the stationary engines in Great Britain alone amounted to an aggregate of 2,200,000-horse power. Assuming that each horse power requires as little as 5 pounds of coal per hour, and that the average run is 10 hours per diem for 300 days per annum, the total coal used by stationary engines alone would amount to 15,000,000 of tons per annum; it is probably far greater than this, judging from the general inefficiency and wastefulness of the existing engines. The au-

1. Paper read by Mr. W. Geipel, M.I.E.E., before the British Association for the Advancement of Science, Section G.

thor's main object is to localize the causes of this waste in the case of our important workshops and factories, and to discuss how this may best be obviated by the use of electricity.

Other objects which he has in view, however, are the attainment of the maximum output of machine tools, which can only be obtained by driving the tools at a steady maximum speed, and the greatest economy in labor, and otherwise in producing the driving power.

In the past there has been a tendency on the part of the trades unions to look upon one at least of the above objects as being opposed to the interests of the workman. American visitors quickly observe the slow speeds in our union-ridden shops. The late strike in the engineering trade has corrected this misconception as to the true interests of the workman, while it has put an end to the harassing policy hitherto adopted by the trades unions which has so long delayed works improvements. The employer is henceforth free to control his own shops, and it is now left to him to make use of every available means of increasing and improving the output. If Great Britain is to continue in her present front position in manufacturing for the world, it behooves her leading employers to take prompt advantage of such improvements as tend in the above direction.

The methods of driving large works more generally in use may be divided into two classes—

One, that in which the power is transmitted by long steam pipes to engines scattered in different parts of the works. This results in loss by radiation and condensation from the pipes, and in loss attending the use of small engines. The other, in which the transmission is from a large engine, by means of wasteful gearing and long lines of shafting and belting.

On the former system are arranged such works as shipyards, rolling mills, engineers' works, etc., where the net consumption of steam may be even 10 times that of an economical engine. On the latter system are works such as cotton mills, where the engine may be highly economical, and yet but 1 per cent. of the power may be applied to the cotton itself.

The advantages and economy obtained by substituting electric power in works using scattered engines are probably more distinct than in the case of works using a single large engine. One of these works alone will use as much energy as is demanded by an average provincial town for its electric lighting. The Bristol Wagon and Carriage Works, for example, use 710,000-horse power hours per annum; that is, the equivalent of over 400,000 Board of Trade units of electric energy, and is considerably more than last year's electricity supply in such towns as Aberdeen, Belfast, Cardiff or Dover.

The directions in which improvement may be looked for are chiefly the following:

Saving of coal.
Saving of water and stores.
Saving of labor and attention.
Reduction of loss in shafting and gearing.
Increased output owing to steady speed of machinery.
Facility of extending by adding extra motors.

Saving of Coal.—Small scattered engines use as much steam per horse power hour as requires 6 pounds to 10 pounds of coal with an average boiler. An economical engine, on the other hand, should not use more than 1½ pounds to 2 pounds of coal. Tests published by Sir T. Richardson in a paper read before the Northeast Coast Institution of Engineers and Shipbuilders confirm this. At his own works there were 31 engines developing from 94-horse power downwards, and using an average of 51 pounds of steam per indicated horse power hour, exclusive of losses in steam pipes. There were required to generate steam no less than 8 main boilers and 23 auxiliary boilers. Electric power has since been adopted throughout these works, with the result that the whole of the main boilers and the majority of the auxiliaries have been replaced by a pair of marine boilers, while there is an actual saving of 100 tons of coal per week. At Messrs. Dorman & Long's, Middlesbrough, six engines were replaced by electric motors, and as a result two Lancashire boilers were dispensed with, while there is a saving of 32 tons of coal per week. At the Bristol Wagon Works five Lancashire boilers are required for the present engines; with electric power plant one Lancashire boiler will suffice, and the saving in coal is estimated at 37 tons per week.

The loss of steam by condensation in pipes is most serious. Even with the best lagging the loss is considerable, while in most works where long pipes are used, the lagging is generally inferior, and frequently there is little or no lagging at all. Roughly speaking, every square foot of uncovered pipe service, if continually under steam and exposed to the atmosphere, condenses annually as much steam as takes ¼ ton of coal to generate; and with covering it may be from that to ⅛ ton. At Messrs. Richardson's the pipes varied in length up to 1,200 feet. At the Bristol Wagon Works there are 730 feet of pipe in use.

Saving of Water and Stores.—With small scattered engines it is generally impracticable to have satisfactory condensing arrangements; therefore, the whole of the feed water is probably lost. With a common engine proper condensing arrangements may be made; and in any case there is a saving in water commensurate with the saving of coal above indicated. With a surface condenser and a cooling pond the water required may be as little as one fortieth of that used by small separate engines. The stores, oil, etc., used by one common engine are, of course, less than those used by a number of engines.

Saving of Labor.—It is obvious that more men are required to attend to a number of engines than to one. It is equally apparent that a reduction in the coal consumption and in the number of boilers in use results in a saving of labor in firing.

Reduction of Loss in Shafting and Gearing.—The loss under this head varies greatly according to the conditions of each case. Professor Kennedy stated in his address to the Institution of Mechanical Engineers in 1894 that for 100-horse power of useful work it required 145 indicated horse power at the engine; that is to say, there was a loss of 45-horse power, of which, say, 13-horse power would be lost in the engine, leaving 32-horse power, or 22 per cent. as the loss in the shafting. Mr. Crompton gives the loss in shafting as 32 per cent. Sir T. Richardson found the loss to vary from 25 per cent. to 70 per cent.; the average was 43 per cent. At Messrs. Furness, Westgarth & Co.'s engine works, Middlesbrough, the loss in one shop, in which two long lines of shafting and a comparatively small number of tools were used, was 75.6 per cent. In two other shops it was 59 and 42 per cent.; or about a general average of 50 per cent. for the whole works. In several different factories in Cleveland, Ohio, Mr. C. H. Benjamin found the loss to vary from 50 to 80 per cent. At the Bristol Wagon Works the loss varies from 22 to 57 per cent.; it is more often nearer to the latter figure.

With efficient electric power plant the losses, apart from engine friction, need not exceed for the dynamo 7 per cent., for the conductors 2 per cent., and for the motors 12 per cent., say, 20 per cent. in all; or making an allowance for lower efficiency of the plant when loaded below the normal, say, 24 per cent. in all. The loss in the conductors is proportional to the load, and is only a maximum when the load is a maximum, and similarly there is no loss in those motors which are out of use. On the other hand, the loss in the shafting is continuous whilst it is running, therefore the efficiency in those cases where machines are intermittently in use, that is the general condition, is considerably below the above figures. For example, if, say, 50-horse power is lost in the shafting continually and there is 50-horse power in use for one-half of the whole time, then in a day of 10 hours there would be 500-horse power hours lost in the shafting and 250-horse power hours used by the tools, so that out of 750-horse power hours, 66 per cent. is wasted in shafting. Frequently the hours of use are even less than half, so that the loss in such cases is still greater.

Increased Output.—It is most frequently to be found in the use of small scattered engines that the governing is defective, and the engines are so loaded that throwing on machines may seriously reduce the speed of the rest of the tools. With good self-regulating motors the speed is maintained constant for considerable excesses even of normal full load. As to the main engine, there is no difficulty in securing governing to practically constant speed; moreover, when large numbers of machines are operated by one main engine, there is less tendency, apart from the governing, to cause a fall in speed than is the case with a smaller engine running a less number of machines. At the Bristol Carriage and Wagon Works one of the existing engines pulls up to one-half its normal speed when the rack saw is thrown on. This, of course, seriously reduces the output of the whole of the tools driven off this engine, added to which there is the increased wear and tear of the machinery and gearing, due to inconstancy of speed. Moreover, it is found with a constant speed that a higher speed may be adopted for the tools, which results in a still further output of work. At Messrs. Richardson's works, for example, where electric driving was adopted, the speed of the tools was increased by an average of 20 per cent., with a corresponding increase of output. In a rail-rolling mill in the United States, where electric motors have been adopted, it is stated that the work hitherto done by 6,000 hands with separate engines is now accomplished by 4,000 with electric power.

Facility of Extending.—As further machinery is added, the makeshift policy of altering the slide valve of the engine to cut off later is frequently adopted, regardless of the ensuing loss of steam. Electric

power is vastly more flexible, it being the simplest matter to add an extra motor when further machinery is put down, so that little or no provision is necessary in the motors.

Method of Applying Motors.—At present the first cost precludes the use of a separate motor to each machine, unless it be a large one. It is generally better to group a number of machines on to one motor, more especially if the load on the machines is variable. Very large powers should not be sent along one long line of shafting; it is better to use two or more motors in such a case. Variable machines should be more or less separated from machines where the load is steady, as it is desirable that in the case of a steady load the motor should be running continually at its most efficient load; whereas, if surplus power be required for a variable machine, then the motor would not run continually at its efficient load. For example, a large fan, which has a constant load, should not be grouped with a lift used intermittently on to one motor. In dealing with heavy work, portable tools driven by motors should be used to obviate the present expense and loss incurred in moving heavy castings from one tool to another. Several of these tools can work at one casting at the same time, thus considerably expediting the passage of heavy work through the shops. Heavy tools, such as lathes and large planers, may remain fixed, but drilling, slotting, shaping, milling, and cylinder-boring tools, should be made portable where work on heavy castings is concerned.

The Bristol Wagon and Carriage Works.

Description of the Old Steam-Power Plant.—There are five horizontal steam engines in all, varying from 100 to 10 indication horse power. Three of the engines are antiquated, having ordinary slide valves, and being controlled by a throttle valve operated by a slow speed governor, while they are so overloaded that the valves are set to give steam practically the full length of the stroke. Two of the engines are modern, having variable expansion gear, while the slide valves are set to cut off and give a fair rate of expansion. Steam is generated in five Lancashire boilers placed in three different parts of the works, near the larger engines. The steam pipes, therefore, are not unduly long, with two exceptions, where the lengths are 158 feet and 112 feet respectively.

Water and Coal Consumption of the Old Plant.—The steam consumption is calculated from diagrams taken at various states of the load. An allowance was made for cylinder and port clearance, but no allowance for loss by leakage past the piston, nor for initial condensation in the cylinder, as the measurement of the steam was made near the exhaust end of the diagram. The re-evaporation which takes place during expansion, would cancel the initial condensation to some extent, though not materially so in all cases. It is impossible, without actually weighing the steam used, to say what deduction should be made for this loss. The following table summarizes the results of the different tests:

	Pounds of Steam per Indicated Horse Power.		
Engine.	Full Load.	Normal Load.	Light Load.
1.....	41	46	58.7
2.....	40	44	47.0
3.....	70	96	93.0
4.....	34	33	48.5
5.....	35	32	32.0
Average.....	44	50	56.5

No. 3 engine, which is the most wasteful, is the smallest, the cylinder being 10 inches by 16 inches. It was found by removing the cylinder cover, that there was an excessive leakage past the piston. If 25 per cent. be added for this and the condensation calculated in 158 feet of steam pipe, which connects it with the boiler, the steam per indicated horse power hour would reach nearly 150 pounds.

The next most wasteful engine is the No. 1, whose cylinders are 18 inches by 30 inches, where the cut-off took place as late as about 80 per cent. of the stroke, while the loss of pressure in the steam pipe, owing to valves and bends, was 20 to 30 per cent. of boiler pressure.

No. 2 engine has also a very late cut off, it being 83 per cent. of the stroke, and the loss of steam pressure between boiler and cylinder is 40 per cent. This engine is greatly overloaded In fact, with heavy load the speed is reduced to one-half the normal, with a consequent loss of output.

Engines Nos. 4 and 5 are not exceptional in lack of efficiency, seeing that they use low pressure steam and are non-condensing. In the case of Engine No. 4, however, there is a steam pipe 112 feet long, of large diameter, and uncovered for two-thirds of its length.

Losses in Steam Pipes.—There are no means of measuring the condensation, which was, therefore, determined by calculation, using a formula based on actual experiment. It has been found that the rate of transmission of heat through iron steam pipes is 3.5 British thermal units per hour per square foot of surface for each degree Fahr. of difference in temperature between the steam and the surrounding atmosphere, and for indifferently lagged pipes with bare valves and flanges the coefficient may be 2.5. Taking the difference in temperature to be 300 – 50=250° F., and the time during which the pipes are in use as 3,000 hours per annum, each square foot of bare pipe would condense about 3,140 pounds of steam, and of covered pipes about 2,250 pounds of steam. The yearly loss by condensation in pipes would then be approximately:

	Pounds Steam.
For 457 square feet of bare pipe × 3,140.....	1,440,000
For 277 square feet lagged pipe × 2,250.....	620,000
Total.....	2,060,000
Adding 25 per cent. for extra surface exposed in flanges, tees, valves and fittings, and conduction through supports and otherwise....	515,000
Total.....	2,575,000

Fuel Consumption.—The total fuel consumed per annum is approximately 2,500 tons, of which between 400 and 500 tons is waste wood, the value of which is about the same as that of coal.

The average load on the five engines is about 254 indicated horse power, and the time of working about 2,800 hours per annum. The energy used per annum is, therefore, about 710,000 indicated horse power hours, and as the normal steam consumption was found to be 50 pounds per indicated horse power.

	Pounds.
The total yearly steam consumption is.....	35,000,000
To this add, say 10 per cent. for leakage past the piston and condensation in engines.....	3,550,000
Loss in steam pipes as above.....	2,575,000
Total.....	41,625,000

This consumption of steam divided by the weight of fuel, 2,500 tons, gives an average evaporation of rather less than 7.5 pounds of water per pound of fuel. Two of the boilers are working under very unfavorable conditions, owing to the length of and restricted and tortuous nature of the flues, otherwise a better evaporative result would have been obtained.

The average consumption of fuel is 7.9 pounds per indicated horse power.

Power Developed by Existing Engines.—A number of diagrams were taken off each engine, under various conditions, and from maximum to minimum load. The results of these are summarised in the following table:

Table of Horse Power Used or Lost at the Bristol Wagon Works.

No. of Engine.	Engine Friction at Maximum.	Loss in Shafting.	Total Lost.	Percentage of Power Lost.	Used by Tools and their Countershafts	Percentage of Power Used.	Light Load.	Normal Load.	Maximum Load.	Power Saved by Dispensing with Countershafts and Engine Friction.
	H.P.	H.P.	H.P.		H.P.		H.P.	H.P.	H.P.	H.P.
1	15.0	21.7	36.7	37.3	61 7	52.7	76.0	98.4	103.7	25
2	7.5	27.2	34.7	73.0	12.8	27.0	40.0	47.5	100.0	21
3	2.0	4.0	6.0	75 0	2.0	25.0	6.4	8.0	11.0	2
4	6.2	11.0	17.2	54.0	14.5	46.0	25.0	31.7	42.0	6
5	14.7	24.0	38.7	57.0	29.2	43.0	60.0	67.9	97.0	22
Total..	45.4	87.9	133.3	..	120.2	..	207.4	253.5	353.7	76

From this table are deduced the following averages:

	Indicated Horse Power.	Per Cent.
Total normal load.....	254	
Loss in shafting.....	87.9	34.5
" engine friction.....	45.4	17.8
Total Loss.....	133.3	52.3
Power utilized by machines and their countershafting or gear.....	120.2	47.7

It will be seen on reference to the table that in the case of engines Nos. 2 and 3, the power lost in shafting and engine friction was no less

than 73 to 75 per cent. In the case of No. 1 nearly half the power of the engine was utilized for driving three powerful fans placed close to the engine, which accounts for the somewhat smaller percentage of loss in the shafting. In the transmission of the remaining 60 per cent. of the power of this engine to the various fitting-shop tools, fully 50 per cent. is lost. These results confirm those obtained by Sir T. Richardson, Mr. Westgarth, and Mr. Benjamin. They are, however, widely different to those published by Professor Kennedy and Mr. Crompton. It may be noted that while the former are the results of actual tests, the latter are presumably estimates.

Power Required by Various Tools.—There is comparatively little data published as to the power required for driving various tools; the author believes, therefore, that the following deductions made from the tests may prove useful:

Large blowing fan for smithy	15 H.P.
Smaller " "	10 "
Large circular rack saw, cutting 2-ft. log of English oak	20 "
Vertical frame saw, when cutting 22-inch by 20-inch pine, with 14 blades	14 "
Planing tool for wood	5 "
Foundry lift	2 "
Horizontal saw for wood	13 "
Circular saw for wood	8 "
Small fan for foundry	5 "
75 miscellaneous tools in engineers' shop, comprising lathes, drills, slotting, shaping and shearing machines, grindstones and emery wheels, etc., of which about 41 were in use whilst indicating the engine	24 "

Power Required for Electric Driving.—The power required by the various tools will be generally increased, owing to their greater output, but the power wasted in shafting and engine friction will be considerably reduced.

Instead of transmitting power from five engines, the shafting will be driven by 10 or more motors. These motors, owing to the small space which they occupy, are placed close to the point at which work is taken off the shafting. For both of these reasons considerable shafting is discarded. For example, in the case of engine No. 2 the normal load is 47 indicated horse power, of which about 20-horse power is lost in heavy underground gear and shafting, most of which is being dispensed with. The total power of the motors to do the present work is 76-horse power less than that now indicated by the engines neglecting loss in transmission; that is, 254 — 76 = 178-horse power.

Coal, Water and Labor on the Electric System.—The new boiler will evaporate at least 9 pounds of water per 1 pound of coal, while the engine will, at working load, which is five-eighths of full load, use 16 pounds of steam per indicated horse power hour. That is, 1.8 pound of coal per indicated horse power hour, or say, 2 pounds in all. Somewhat better results than this might have been obtained by the use of a more complicated plant, but it was decided that the extra first cost would barely compensate for the small additional saving.

It has been stated above that the motors will develop about 178 horse power to do the present work. To this must be added the losses in the new transmitting system. The efficiencies may be taken as follow:

Engine friction and ropes, say	90 per cent.
Generator efficiency	92 "
Conductors	98 "
Motors, average	85 "
Total efficiency	69 "

Each horse power at the motor pulley, therefore, requires 1.45 indicated horse power at the engine cylinder. The normal indicated horse power of the new engine will be about 178 × 1.45 = 258 indicated horse power, which is within 2 per cent. of the power developed by the old engines.

Taking 2,800 hours of work per annum, there are, then, 725,000 indicated horse power hours, which at 2 pounds of coal per hour consume 650 tons of coal per annum. There is thus a saving of 2,500 — 650, say, 1,850 tons of fuel.

The water required on the new system will be about 10 per cent. of 16 pounds, say, 2 pounds per indicated horse power hour for making up the feed, and about 4 pounds for making up that lost in the cooling apparatus, say, 6 pounds of water per hour. So that the yearly consumption of water will be 435,000 gallons, or a saving of 4,162,500 — 435,000 = 3,727,500 gallons, a large part of which has been hitherto purchased from the town water works. In addition to this there will be a saving of oil and stores as well as of labor, inasmuch as there will be only one fireman in place of those at present required.

The total saving is approximately £1,000 per annum, quite apart from the other various advantages.

Reasons for Adopting the Three-Phase System.—Full consideration was given to the merits and demerits of the direct current and three-phase systems, and the directors of the Bristol Wagon Works took the opportunity of seeing both systems in practical work under conditions analogous to those in their own works. The first cost of the two systems was approximately the same, while the following are the advantages of the three-phase system which appealed to the Bristol Wagon Works Company:

1. The absence of commutators on both generator and motors, and the fact that the current passes direct through clamped terminals from the generator to the motors.

(It was noticed that the commutators of the direct current motors and dynamos were worn and caused trouble, more especially in comparatively dirty workshops.)

2. The more mechanical design and construction of the generator and motors, the windings of the latter, being entirely enclosed by the iron frame of the machine, protecting them from accidental damage.

3. The fact that the three-phase motors can be left running for long periods without any attention, even when considerably overloaded, which is not advisable in the case of the direct current motors.

4. The freedom from possibility of breakdown as compared with the direct current system.

Brief Description of the Electric Plant.—Steam will be generated by one Lancashire boiler 28 feet by 7 feet 6 inches, fitted with a Bennis automatic stoker. The stoker is regulated by a piston in communication with the boiler, which throws the feed in or out of gear according to the steam pressure. The piston also operates a damper in the main flue, so that the pressure of the boiler is automatically maintained constant within 2 pounds. It is, therefore, only necessary for the fireman to fill the hopper with fuel and regulate the feed. A Green's fuel economizer will be inserted in the main flue, while there is provision made at the back of the boiler for the insertion of a superheater.

The engine, in order to provide for extension, is good for 400 indicated horse power, and is of the horizontal compound type, having cylinders 13¼ inches and 25 inches in diameter by 32 inch stroke placed on either side of the flywheel. The admission valves are on the Proell system with Corliss exhaust valves. The air pump, which is of Edward's type, will be worked by a bellcrank off the end of the low pressure piston rod. A centrifugal pump driven off the shafting will circulate the cooling water. A surface condenser with 650 square feet of cooling surface will be placed at a sufficient distance from the engine to admit of a filter for removing the oil before the exhaust passes to the condenser. As there is neither a natural supply of condensing water nor a cooling pond available, a cooling tower will be used for cooling the circulating water.

The generator, which is of the Brown-Boveri type, will be driven off the flywheel by ropes, while the adjacent fitting shop shafting will be also so driven off the flywheel. The generator will absorb 275 brake horse power, and is provided with sliding foundations.

The main switchboard will consist of three panels, one being for the generator with a regulator for the exciter; another for the motors, each circuit having a triple switch and fuse and ammeter; the third for the lighting circuit, with double switch and fuse on each circuit. The boards will consist of enamelled slate mounted on iron supports, so as to be entirely incombustible, no wood whatever being used.

There will be seven motor circuits, that is, one to each shop, each circuit being composed of three conductors. The number of motors at first will be 10, varying from 65 down to 2-horse power. The larger motors, viz., those of 65 and 50-horse power, will drive by ropes, the smaller motor by belts.

There will be about eight lighting circuits, one running to each department. They will consist of two wires only, one being the phase wire, the other being connected to a fourth or neutral wire, which is connected to the center of the star winding. The voltage of the motors will be 190 and of the lighting circuits 110.

The lower voltage was adopted for the lighting circuits to enable the use of more efficient glow lamps, and to be at the same time more suitable for the arc lamps. There will be 750 glow and 32 arc lamps, which will give a better illumination at considerably less cost than the present gas lighting.

The whole of the conductors will be insulated with rubber, and run in hard wood casing throughout.

The generators and motors are being supplied by Messrs. T. Richardson & Sons, of Hartlepool, while the whole of the work is being carried out by the firm with which the author is associated.

Employers' Liability for Hazardous Electric Appliances.

By Mr. R. D. Fisher, in *Electrical World.*

The rapid advance of electricity within very recent years as a factor in commercial and economic affairs, has given rise to a considerable body of statute law, and to numerous judicial decisions involving in some respects the creation of new legal rules, which concern chiefly the application of well-established principles to new conditions of fact and circumstances. A most valuable feature of legislation is the bulk of statute law enacted for the purpose of fixing the rights and liabilities of electric corporations of various kinds. The body of the law relating to the duties of companies as carriers of messages and of passengers, and their liability for negligence, has been many years accumulating, and has become to a great extent settled; but a different problem is presented with reference to extra hazardous appliances furnished to the employee which involve the liability of the employer to an injured servant in consequence thereof. The apprehension which a prospective loss of employment engenders often amounts to a coercive influence, and this being so, courts are at a loss to know how much allowance ought properly to be made for the action of that influence on the mind of the servant.

If it is assumed that the fear of losing remunerative work does not deprive of its voluntary quality the action of a servant who continues in his employment with a knowledge of the existence of conditions which make the risk of injury greater than that which persons engaged in the same class of work are ordinarily called upon to incur, the conclusion is inevitable that an employer is entitled to carry on his business with even the most defective and dangerous instrumentalities, provided the servant, either by his own observation or as a result of instruction and warning, has attained full comprehension of the hazard to which he is exposed by the use of these instrumentalities. This conclusion the courts have not been at all backward in drawing. The judgment that the master was not liable has induced legislatures to enact truck acts, factory acts and employers' liability laws. According to English law the master may be guilty of the most cynically reckless neglect of duty regarding the hazards of machinery, and yet not be liable. Lord Bramwell, in the case of Dynen v. Leach, 26 L. J., Exch. 221, said: "There is nothing legally wrongful in the use by an employer of appliances or machinery more or less dangerous to his workmen, or less safe than others which might be adopted. It may be inhuman so to carry on his plant as to expose his workmen to peril of their lives, but it does not create a right of action for an injury which it may occasion when the workman has known all the facts, and is as well acquainted as the master with the nature of the machinery and voluntarily uses it."

The following passage from a Connecticut case will suffice to show how closely the American judges have echoed the sentiment of their English brethren:

"Every manufacturer has a right to chose the machinery to be used in his business in the manner most agreeable to himself, provided he does not thereby violate the law of the land. He may select his appliances and run his plant with old or new machinery, just as he may ride in an old or new carriage, or occupy an old or new house, as he pleases. The employee having knowledge of the circumstances and entering his service for the stipulated reward cannot complain of the peculiar tastes and habits of his employer, nor sue him for damages sustained in and resulting from that peculiar service." (29 Conn., 548.)

Compare the language used by the Massachusetts Supreme Court to the effect that it is the legal right of every person to carry on a business which is dangerous, either in itself or in his manner of conducting it, if it is not unlawful and interferes with no rights of other persons. (102 Mass., 572.)

So the Michigan Supreme Court construed the doctrine of assumption of risks very strongly in favor of the employer, saying: "Obvious imperfections in methods or machinery, existing at the time of the employment, cannot be made the basis of a liability in favor of an employee who suffers an injury in the cause of his employment, since the employer has the right to have and use imperfect methods and tools, and to ask others to enter his employ to aid him in such use, and in so doing does not undertake to insure the employee." (97 Mich., 265.)

The general rules governing the operation of electric plants so far as concerns the employees are the same as those governing the relations of master and servant in relation to other electric plants, viz., that an employee is supposed to accept the obvious risks of the employment, and cannot recover for accidents caused thereby. To show how low the standard of duty is fixed the Wisconsin Supreme Court (87 Wis., 387) held that where a motorman was obliged, after removing a trapdoor in a car, to put his arm near the revolving axle and gearing in an attempt to clean the commutator, his coat sleeve being caught and his arm drawn into the gearing and mangled while so doing, he having been instructed for eight days in the duty of a motorman and having been employed three days before the accident happened, having also seen other motormen clean the commutator, the schooling given him was sufficient, and that it was an obvious risk of the employment for which no recovery could be had.

Electric cars sometimes, owing to defective machinery, act stubbornly. This trick is called by the motormen "bucking," and may produce serious results. In Minneapolis a car so bucking threw the motorman over the dashboard, and then starting again ran over and killed him. The motorman had been employed a year. He notified the company of the defective machinery, and repeated attempts were made to remedy it. The court held the company liable in this case because it had notice of the habits of the car and had failed to remedy it in that it failed to replace a defective field coil in the rear motor, and it was negligence in the repairer not to remedy this defect, knowing of the bucking habit of the car. (54 Minn., 504.)

If the degree of care which the servant must exercise in order to escape injury is greater than that which, considering the exigencies of the work and other matters which are likely to divert his attention and produce a temporary forgetfulness of a known danger, it is reasonable to demand from men of average prudence and powers to use ordinary diligence in the discharge of their functions, and make it a breach of duty in the master to keep his instrumentalities in such a condition that ordinary diligence will not always save the servant from injury. It would simply make his liability dependent upon whether he had or had not acted unreasonably, and therefore negligently, in holding out inducements to do work which could not be performed safely without the exercise of a degree of care which no fair-minded, considerate person would demand from a servant. This would prevent the cruel abuse of the doctrine of assumption of risks which has done so much to embitter the feelings with which capitalists or operators are regarded by the working classes of the country.

SPECIAL ENGLISH CORRESPONDENCE.

Communicated by Norton H. Humphrys.

Salisbury, England, November 10, 1898.

Increased Use of Gas for Cooking.—A Strange Blunder.—The Vagaries of Electric Lighting.—Reliability of Gas.

Last month I referred to a piece of outside evidence as to the increasing use of gas cooking stoves, and since then have come across another item that is equally interesting. A number of persons were summoned at a London police court for failing to keep up the payments due for the maintenance of their children in industrial schools. One of the defendants was a chimney sweeper by trade, and he pleaded inability to pay by reason of a decline in business during the summer. The penny-in-the-slot business, he added, had destroyed it, and people used gas for cooking purposes, and, therefore, did not require their chimneys swept. But the use of fires would now begin, so he hoped to get some work about Christmas time. We are sorry for this particular chimney sweep. The small trader usually lives from hand to mouth, and cannot stand even a few weeks' loss of business without suffering actual hardship, and is, therefore, entitled to every possible consideration. The gas companies require to take on additional inspectors and collectors in order to cope with the rapidly increasing slot business, and when filling the next vacancies, the position of chimney sweepers and others whose trade may have suffered should be considered. It would be a graceful act of consideration if vacant situations were placed at the disposal of persons of this class whose character would bear investigation. But turning to the consideration of public health and comfort, we must remember that the soot remaining in the chimney represents a very small part of that which escapes into the atmosphere. And that the loss of trade to the chimney sweep means a substantial contribution towards a clearer atmosphere and the reduction of that terrible nuisance, the London fog. This little incident led a reporter of a daily paper to seek an "interview" with a chimney sweep in order to obtain further information, and the selected subject, while woefully ignorant in respect to grammar and pronunciation, was capable of presenting the case in a few concise sentences. He agreed that the plea of the above named defendant was correct, and added that gas stoves were so convenient that he did not wonder at their coming into general use. He

had one himself, and all one had to do was to strike a match, light the gas, and there you are.

An extraordinary blunder has been made by the Committee of the Midland Association of Gas Managers. They held a meeting on the 27th ult., and one of the items on the agenda was a paper[1] by Mr. McGregor, of Longton, on the reconstruction of the Longton gas works. This paper was promised some months since, and only recently the Gas Works Committee at Longton decided to have a formal inauguration of the new works, to be held on the 20th ult. An invitation to attend this ceremony was sent to the *Journal of Gas Lighting* and was accepted, and as a result a full description of the proceedings, with details of the new works as furnished by a descriptive pamphlet presented to each visitor, duly appeared in the issue of that publication on the 24th. Mr. McGregor wrote to the Secretary, suggesting that as his paper had been somewhat forestalled by the *Journal*, it might be well to take it as read. But the Committee, somewhat rashly, seem to have concluded that Mr. McGregor was in some way responsible for the *Journal* report, and that he had divulged the contents of the communication promised to the Association. They considered themselves injured, and decided to refuse the paper altogether. The truth was that Mr. McGregor was not responsible for the date of the opening ceremony, for the issue of invitations to Longton or for the preparation of the descriptive pamphlet. The whole thing was beyond his control. He had prepared his paper, which, as might be expected, differed in several important details from the published description and had not divulged its contents. Fortunately for the credit of the Association and the dignity of the Committee, these facts came to the knowledge of the President during the course of the proceedings, and were fully explained by him at a later period. He concluded by moving that Mr. McGregor's paper be included in the proceedings, which was unanimously agreed to. It is a misfortune, probably felt by none more keenly than by the Committee themselves, that these facts did not come to their knowledge before they took action. Mr. McGregor must have felt deeply wounded. The unfortunate incident is worthy of notice, as showing the need for full and careful inquiry into all the facts before deciding a case of this sort, and also as illustrating the responsibility incurred in promising a "paper" some time beforehand.

Electricity has been behaving very badly of late, in all parts of the country, and without prejudice for or against any particular system. Within the last fortnight of October there was reported a sudden extinction at Brighton, due to the failure of an "automatic" cut-off to justify its title. At Dublin the supply to the public lamps was miserably insufficient, which was accounted for by the relaying of cables, necessitating the stoppage of some circuits during the operations. At Oldham 20 minutes' darkness was due to the man in charge at the works, who got fogged at the switchboard and shut the current off when he supposed he was putting it on. At the Hampstead Vestry (London) several complaints as to failure of the electric light were made, but the chairman depreciated these public admissions of the failure of the electric light. It is needless to add that the undertaking is the property of the vestry. The consumers who had suffered by reason of the failures will do well to consider whether they are better off under a municipal supply, with their complaints hushed up, than they would be under private enterprise that would be amenable to public opinion. Then at Wolverhampton there was a two or three hours' stoppage on a Saturday evening, the cause of which was officially reported as "the failure of two generator armatures at the main station." At nearly the same hour, a similar state of things was prevailing at Cambridge, a considerable portion of the supply being totally stopped for an hour. It is said that "failures teach more than successes," and, therefore, we may expect that the *technique* of electric lighting is rapidly advancing.

All this is taken in remarkably good part by the public, who are inclined to be indulgent towards the light of the future, and to believe that the deficiencies of the present will be compensated for by something of a transcendently glorious character bye and bye. As a prominent electrician has rightly observed, faith is a great necessity in the practical application of electricity. Certainly it has, up to the present, fallen very far short of all that has been promised on its behalf by scientific godfathers, and the public in general do not expect so much from it as they do from gas. This is illustrated by the prominence that has been given to a 20 minutes' stoppage which occurred a few weeks ago in a seaside resort, and which has received more attention in the public press than all the examples first named taken together. Not that I am disposed to quarrel with such a state of things, or to claim that gas should receive as much consideration and forbearance as have been so freely accorded to electricity. That it does not do so is really a compliment to its reliability. Artificial light has become such a necessity of modern life that reliability is the chief consideration. The risks and losses due to sudden extinction are of such importance as to far outweigh differences in cost, or within moderate limits, of quality or other considerations. So everything possible in the way of maintaining the reliable character of gas must be done.

Fortunately the distributing plant at a gas works is of such a simple character that a very moderate amount of supervision and systematic working will render it as safe as anything can possibly be. In fact, the very simplicity is a source of danger, as it leads to taking too much for granted, to leaving the manipulation of the valves, etc., to ordinary workmen, and so on. This would not be done with apparatus of a more elaborate character. The distributing plant is practically independent of the manufacturing and purifying apparatus, which may be thrown out of action for hours together, without interfering with the supply. That an easy job is more troublesome than a hard one is a common experience. If the ground that is excavated for the purpose of making a gasholder tank proves to be unusually sound and water-tight, the chances are that the contractor, if left too much to himself, will be inclined to stamp little details as being unnecessary, in a manner that he would not dare to attempt when dealing with ground of a more uncertain nature. And so the gas engineer is apt to forget that the gas supply, even of a small district, is of sufficient importance to warrant every care and continual supervision.

In connection with ordinary drip boxes, whether on the works or in the district, Mr. I. Cross makes a very useful suggestion in the *Journal of Gas Lighting*. He has used the plan for many years, and it consists of adding a test pipe in addition to the suction pipe to each drip box. This test pipe is carried to a sufficient depth, say half the available depth of the siphon, and extends through the cover, where it terminates in a stopcock. The idea, it will be observed, is analogous to the bib taps on a boiler. After pumping out a drip box, gas should escape freely if the cock is opened. The great advantage of this plan is that the manager himself can in a few minutes go round the works and satisfy himself that all the drips are clear. If there is a stoppage he can, with equal facility, locate it as between one siphon and another, and if an accumulation of water is the cause, the remedy can be quickly applied. A periodical examination of the drip boxes is not a difficult matter, but this is often partly or entirely neglected. A successful gas manager once told me that he never pumped out his siphons, as they never had anything in them. If an emergency happened at his works, therefore, the chances are that the siphon pump could not be found for some time, or that it would require an hour's tinkering to get it to work.

1. See JOURNAL, *ante*, p. 718.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

Mr. E. C. Hathaway Notes a "Few Things."

CHARLOTTE, N. C., Nov. 19, 1898.

To the Editors AMERICAN GAS LIGHT JOURTAL: Recent numbers of the JOURNAL state the fact, and it will be welcomed with delight by all the fraternity, that a well-known educational institution has decided to add a gas engineering course to its curriculum.

In view of this, and the further fact that the Practical Class has taken a new lease of life, permit me to say a few words, which, if not having the merit of originality, are at least true, and will be so conceded by the mass of mangers in charge of small undertakings.

The experience of every gas man who is self-educated, or who has honestly tried to educate himself, is a bitter one in many ways. He finds himself engaged in a profession worthy of the brightest minds in every respect, which positively has no national textbooks or literature, everything written upon the subject contained in bound and printed volumes being taken from English or French authorities, based upon measurements and couched in terms that are foreign to him.

Correct, it is true, and valuable these are in their proper sphere; but in most cases they involve the possession of expensive apparatus, a fair equipment of which would involve the expenditure of at least a year's salary of the average man to even follow and prove the formulæ contained therein.

Imagine, for a moment, the look of horror and surprise that would overspread the faces of his executive board should the average manager try to convince them that the successful operation of his works necessitated the purchase of a complete analytical outfit, sulphur test and bar photometer with its proper accessories! Yet the study of the chemistry of gases or the principles of photometry without these would be

like trying to acquire a civil engineer's course without his having seen or touched a level or transit. To properly impress these matters upon the mind is to have ocular demonstration of them.

But why enumerate? The average man is testing his meters with a portable prover, such as is used by our friends the itinerant inspectors; and, far from obeying the cardinal directions as to temperature, pressure, etc., is conducting the tests in a shoproom on the gas works yard.

As for photometric work, how many bar photometers are there in this country, in towns of 20,000 or less? Few, indeed, and fewer men that can use them.

The photometric outfit in most plants consists of one, or possibly two, jet photometers which a careful perusal of "Richards" will show is a rheometer burner equipped with a graduated chimney, and acquires its name from the chimney, no credit having been given for the burner governor which made it a possibility.

You will probably ask what does this, and volumes more that could be said upon the same subject, lead to? Simply this: In measuring the manager of small plants to-day, what standard is used? Is it his knowledge of technics? No; or should be no. But, first, last and all the time, it is his ability to get and hold business, and to keep thoroughly in touch with his townspeople.

And the following are a few of the many things he must know:

Of course it is a *sine qua non* that he should economically manage his plant; keep both his holders and collections up; keep his plant in repair, so far as his board will let him; after this to get business and keep his customers satisfied at all times.

The gas consumer, taken collectively, is a crotchety creature at best, and the only way to manage him is to make him believe that the eternal salvation of the enterprise depends upon satisfying him and retaining his custom, even if his bill is only $12 per annum. In consequence, the festive gas man should be a compound like Will Carleton's editor of "Moses and Solomon Both."

He must be able instantly and from memory to give the value of any competitive system of illumination as compared with gas, in candle power, for the money expended, and show conclusively that the disadvantages of each make gas the cheaper and more satisfactory lighting agent. And he must do this in a manner that bears the stamp of truth and a thorough knowledge of his ground, whether the system be candles, oil, electricity or acetylene, laying stress at all times upon this statement (to the customers, who concede he is a good fellow, but his company are extortionists), that it is in no sense a personal matter. He is representing his company, and its policy is at all times a broad and liberal one.

And to whom are the stoves and other appliances sold that go to help out the day consumption? The ladies, of course. And to this element and branch of the business he must devote the best that is in him, never for a moment appearing the least impatient when told that the gas for the month has been poor, the bills large, or that Mrs. So-and-so.'s "stove bakes better than mine, and uses less gas." He must be ready to explain the apparent perversity of inanimate things; to investigate and fit the stove that does not bake; make a small peace offering of business and attention to help the refractory bill; to help the young lady artist with her china kiln; explain, if it takes only 200 cubic feet to fire on Monday, there is no reason that it should not take 256 feet upon Friday; when and how to get the best heats and at what time of day the pressure is best; and, last of all, a general knowledge of ceramics, involving the heats necessary to fuse the different compounds, etc.

He must be ready at an hour's notice to set a range for the ladies' bazaar, showing them how to use it no matter how busy he is; be ready at all times to doctor a refractory engine, tell why it won't work, and put it in shape; and last, but not least, he must earn dividends upon his stock and bonds (even if the capitalization does seem large as compared with the actual investment) or he will not be tolerated for a moment.

These, dear Editor, are a few of the things the country gas man has to know. And not until he occupies the seats of the mighty, and is permitted to read papers at the Association meetings, is it safe for him for a moment to forget them. Truly yours, E. C. Hathaway.

It is said that large deposits of coal have been found in Ontario at levels at which it was a received article of geological faith that there could be no coal, the strata being too ancient. The strata belongs to the Cambrian period, and the quality of the coal is that of excellent hard anthracite.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At the annual meeting of the shareholders of the Welsbach Commercial Company, held in this city the 7th inst., the following Directors were elected: Chas. B. Van Nostrand, Henry Seligman, Emerson McMillin, W. F. Douthirt, Samuel Thomas, W. S. Block, Thos. Dolan, Wm. E. Barrows, Samuel T. Bodine, Randal Morgan, Edward C. Lee, Samuel R. Shipley and George Philler. At the meeting a dividend of 1 per cent. was declared, payable December 10th next. The transfer books close the 30th inst. A man prominent in the management of the Company, in referring to the reduction in the dividend rate, said that, while the surplus earning of the Company was sufficient to stand the usual dividend of 2 per cent., the Directors considered that the competition in the sale of lights called for a conservative course, until the status of pending suits over the validity of patents and the net result in receipts from sales of lights and mantles had been definitely ascertained. It was further averred that the Company owed no other money than that demandable in respect of current trading account, and that its net cash assets amount to something over $500,000.

Last week we had occasion to report that an explosion in the boiler room of the Richmond (Ky.) Water and Light Company, which explosion caused considerable damage to its plant, resembled much the designed act of a miscreant. Since that writing we received a copy of a circular, issued by the Company to the residents of Richmond under date of the 18th inst. The circular reads: "About 8 years ago the Richmond Water and Light Company erected a system of water and gas works, and has been furnishing water and gas to the city and its inhabitants under a contract previously made with the city. On last Saturday morning (about 1:30 o'clock) an explosion occurred at the gas house which wrecked the large brick building, destroyed the exhauster, rendered the boiler useless, and shook and startled the entire city. The night engineer miraculously escaped with a slight bruise; he had put coke into the firebox just before the explosion. The Company and its officers were slow to believe that this explosion was the work of design, although some one some time ago maliciously attempted to wreck the pumping station at the water works station. Since the explosion at the gas house, it has had several experienced and competent mechanical engineers, including H. Heine, of Cincinnati; G. A. Ray, A. E. Carse, D. J. Dougherty, J. B. Brawner and others to examine the wreck, and they have unanimously reported that there was no steam or gas explosion, and that the wreck was caused by dynamite, or some other powerful explosive, being placed either in the firebox attached to the boiler or placed in the coke used in the firebox. The boiler did not explode at all, and is now in good condition, excepting the end that was attached to the firebox. The firebox is turned wrong side out, is twisted badly and plainly shows that the explosion occurred in it. Steam explosions are upward and essentially different from dynamite explosions. The injury to the firebox and boiler, and the jar that threw down the building, which jar was felt throughout the city, conclusively established the cause as dynamite or other powerful explosive placed in the firebox. There was no gas explosion after the dynamite discharge, and all the delicate machinery in the purifying and condensing rooms is uninjured. The Company at once ordered the necessary machinery, took steps to furnish gas as speedily as possible to the city and its citizens, and to restore the wrecked building, and was able to resume to some extent last Tuesday night. It asks the kind indulgence of its patrons for a day or two longer, when it hopes to be able to supply its patrons fully. It has been unable to discover the criminal who has shown such utter disregard of human life and property, but it will never relent in its efforts to detect and punish whoever may be the guilty party or parties."

The authorities of Brockton, Mass., have determined to test the availability of the improved Welsbach lamp for purposes of street lighting. This really means that Brockton will go in for the lighting on a fairly large scale.

The semi-annual report of the Board of Public Works, of St. Paul, Minn., shows that the number of public lamps in use on that city's streets may be thus apportioned: Gas lamps, 2,644; gasoline lamps, 3,011; electric lamps, 257.

An important oil strike is reported from Corsicana, Tex., the discovery being thus described by a correspondent who wrote under date of the 15th inst.: "The talent in the Texas oil fields are somewhat at sea because their pet theories respecting oil deposits in and about Corsicana have been sadly disturbed, because an important oil strike was made last evening, at a point 5 miles south and 30° east of the city, on the

John Gibson 700 acre tract of land. The well was a venture of Judge Rufus Hardy and others, and it looks now as if it would open up another new field. It is full 2 miles distant from the well on the W. J. McKee place, which was drilled by W. H. Staley, of Pittsburg, Pa., and the strange feature is that oil was found in it at a depth of 825 feet, while in all other wells in the field oil was not found at a less depth than 1,040 feet. This is held to show that a new oil-bearing sand has been struck, and if the deposit of oil is in paying quantities new calculations will hereafter be made in drilling wells. The new strike has been visited by several people from the city to-day, and they brought back confirmatory reports."

THE San Francisco *Chronicle* reports that the works of the Equitable Gas Company, which are located at the foot of Hyde street, San Francisco, were satisfactorily tested on the evening of the 16th inst. The Superintendent of the Company is Mr. A. C. Swain.

THE Pittsburg (Pa.) papers report an odd accident from an escape of gas, which happily ended without fatal results. The facts in the case are: Two dressmakers (Kate and Lizzie Kelly, of Scranton, Pa.) retired to rest the evening of November 14th. In their room is a small gas stove, the gas supply to which is from a rubber tube attached to one of the burners that lights the apartment. Before the women retired the gas was shut off at the stove cock instead of at the cock on the gas fixture. During the night a rat gnawed the tubing and the gas escaped into the apartment. Luckily one of the women awoke with consciousness sufficient to enable her to crawl out to the hallway. The noise made by her movements awoke Dr. Senderling, who occupies an apartment on the floor below. Help was speedily summoned, and in time the women were restored to consciousness.

THE proprietors of the Toledo (Ohio) Gas Light and Coke Company have virtually determined to build a handsome office structure on the premises owned by the Company on St. Clair street, adjoining the Produce Exchange building.

THE Wilkes-Barre (Pa.) Company has moved into its handsome, new office quarters, No. 39 North Washington street.

THE new holder for the Toledo (Ohio) Company has been completed to the entire satisfaction of Manager Faben.

IT looks that the Mayor of Somerville, Mass., Mr. A. A. Perry, has more than a fatherly interest in the spread of the electric lighting service for that city; for at a recent meeting of the Board of Aldermen he vetoed an order passed some time ago, which authorized the committee on fuel and street lights to locate 11 Welsbach lamps. In the veto message Mayor Perry said that inasmuch as the Somerville Electric Light Company had put in 32 candle power incandescent experimental lamps, that no more Welsbach lamps should be placed until the Company's claim, that the incandescents were equal in light-giving power to the 60-candle value of the Welsbach lamps, was settled. On his suggestion the Superintendent of *electric lights* was instructed to make a test of both lights, and the order was laid on the table until the next meeting, pending the results of the test.

THE Young syndicate is said to be in treaty for the plant, franchises and contracts of the New Britain (Conn.) Gas Light Company.

MANAGER FABEN, of the Toledo (Ohio) Gas Light and Coke Company has arranged for the placing of a 24-inch pipe under the Maumee river for the better supply of gas to the upper portion of the city. The starting point is to be at the foot of Adams street, and the work will be done by Messrs. Thacher & Shirey.

AN attempt is being made to reanimate the Provident Gas Company, which corporation has a franchise to operate an opposition works in Springfield, Ills. Messrs. F. W. Tracy, R. D. Lawrence and Stuart Brown have been appointed a committee to obtain figures respecting the cost of the necessary plant.

MR. L. W. ROSS, as special master-in-chancery, United States Circuit Court, has named the 9th prox. as the date for the sale of the plant of the Council Bluffs Gas and Electric Light Company, to satisfy the mortgage held against it by the Farmers' Loan and Trust Company of New York. The sale will cover the entire plant of the Company, its franchise, real estate, etc. The terms of the sale dictate that all bidders must first deposit certified checks amounting to $8,000, or else, $30,000 of the Company's mortgage bonds, and the purchaser must immediately deposit, after the property is knocked down to him, 5 per cent. of the purchase price with the master in-chancery. The suit brought by the Trust Company is a friendly one, intended to further the reorganization of the Company, which will be completed as soon as the sale is effected.

AS was noted a week ago in the JOURNAL, the Hackensack (N. J.) Gas and Electric Company has absorbed the Bergen County Gas Light Company, of Englewood, N. J. The new proprietors will extend their main system to the adjoining or outlying towns of Tenafly, Leonia, etc.

THE Consolidated Gas Company, of Baltimore, pays a dividend of 2 per cent. on the 1st prox.

GOING back to the transfer of the Englewood gas property, in completion of that mention it should be said the price paid was $250 per share, and that the purchasers (Messrs. F. B. Poor and associates) have notified the minority shareholders that the named price will be paid them for their holdings, provided the acceptance is made on or before December 1st.

THE Metropolitan Street Railway Company, of Kansas City, Mo., has equipped its cars with the Pintsch system of gas lighting.

MESSRS. A. M. GOULD and A. O. Clephane, receivers of the Washington (D. C.) Gas Consumers Association, having disposed of that Company's affairs as far as its assets would permit, have been released from their bonds.

THE work of mainlaying for the gas annex, which the Torrington (Conn.) Electric Light Company proposes to maintain, is underway. The Company proposes to put in services, to the house line, without charge.

THE "opening" of the works of the Peoples Gas Improvement Company, of Trenton, N. J., was performed, as per programme, on the 15th inst. It is said that over 2,000 persons visited the works on the opening day. The Trenton *Gazette*, in reporting the matter, among other things, said: "Mayor Sickel, after a brief speech, lighted, at 19 minutes past 3 o'clock, two burners from which shot blazes 2 feet high. The crowd cheered loudly. In lighting the gas Mayor Sickel exclaimed, 'This marks an era of cheap gas and fuel for the city of Trenton.'"

PATRICK J. MURPHY, for many years works' foreman of the Citizens Gas Company, of Willimantic, Conn., died suddenly the afternoon of the 12th inst. He was in his 60th year.

THE Green Bay (Wis.) City Council has entered into a contract with the Green Bay Gas and Electric Light Company for the public lighting of that place for a term of 10 years.

A PRONOUNCED cut has been made in its selling rates by the Oroville (Cal.) Gas, Electric Light and Power Company.

THE Logan Iron Works has just entered into a contract to erect four large smokestacks (125 feet in height) with connections, to be set up in Honolulu.

The Market for Gas Securities.

The market for city gas shares remained within narrow limits during the week, although the tendency was irregular. Consolidated opened to-day (Friday) at 187½, which price it should be remembered virtually includes the regular quarterly dividend of 2 per cent., that in the usual order of things is payable December 15th. Standard preferred is at the figures of a week ago, while the common is 135 bid, with every indication that higher prices will be shortly recorded for it. Amsterdam common shows a slight decline, but the preferred is stronger. The "dispute" for business still continues. Central Union fives are in request; in fact all gas bond issues of repute are in good demand.

Brooklyn Union is 127½ to 127¼, ex dividend. Peoples, of Chicago, on the "rights" to shareholders of record over the proposed new issue of stock, sold above 110 during the week. Cincinnati gas sold up to 207, on the publication of the facts respecting the proposed new issue of stock. Bay State hovers between 4 and 5. Lacledes show no particular change, and a like remark applies to Consolidated, of Baltimore. Syracuse gas is weak and lower. The Newark (N. J.) reorganization has been completed. Some mention of its details will be found in our current editorial notes. Western gas, of Milwaukee, more than maintains its recent advance, and New Haven (Conn.) shares are rapidly increasing in value.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

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MONDAY, NOV. 28, 1898.

Gas Stocks.

Quotations by Frederic B. Cochran & Co., Brokers and Dealers in Gas Stocks.

20 AND 22 BROAD STREET, NEW YORK CITY.

Nov. 28.

☞ All communications will receive particular attention

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$37,730,000	100	186	187½
Central Union, Bonds, 5's.	3,000,000	1,000	101	101½
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	.	108	112
Mutual	3,500,000	100	305	315
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co.	13,000,000	100	27	28
Preferred	10,000,000	100	66	67
Bonds, 5's	11,000,000	1,000	101¼	102
Northern Union, Bonds, 5's.	1,250,000	1,000	94½	95½
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	111	113
" 1st Con. 5's	1,500,000	..	107½	108½
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	135	139
Preferred	5,000,000	100	150	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	127⅜	127½x
" " Bonds (5's)	15 000,000	1,000	115	116
Bay State	50,000,000	50	4⅛	4⅝
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works..	450,000	100	..	..
" 1st Mtg. 5's	450,000	1,000	..	..
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	92	..
2d " " "	3,000,000	1,000	..	80
Buffalo City Gas Co.	5,500,000	100	18	18½
" " Bonds, 5's	5,250,000	1,000	93	93½
Central, San Francisco	2,000,000	..	105	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,144,700	100	89	91
1st Mortgage	1,207,000	1,000	101	103½
Consumers, Jersey City	2,000,000	100	80	..
" Bonds	600,000	1,000	102	104
Cincinnati G. & C. Co.	8,500,000	100	206½	206¾
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	65	66
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	..
Consolidated Gas Co. of N.J.	1,000,000	100	16	21
" Con. Mtg. 5's	380,000	1,000	75	80
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,560,000	50	65	65½
" Prior Lien 5's	4,546,000	1,000	94¼	94½
Detroit Gas Co., 5's	423,000	1,000	..	..
" Inc. 5's	31,000	100	..	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	75	80
" Bonds	2,000,000	..	88	
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	.
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	115	125
" Bonds, 6's	2 650,000	..	106	107
Jackson Gas Co	250,000	50	..	..
" 1st Mtg. 5's	250,000	1,000	..	..
Jersey City	750,000	20	210	..
Lafayette Gas Co., Ind.	1,000,000	100	78	83
Bonds	1,000,000	1,000	90	91
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	48½	49
Preferred	2,500,000	100	94½	95
Bonds	10,000,000	1,000	105½	106
Madison Gas & Elec. Co.	400,000	100	..	..
" 1st Mtg. 6's	350,000	1,000	..	..
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x
New Haven	1,000,000	25	252	..
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	53½	55
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	110	110⅛
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	240	250
Rochester Gas & Elec. Co.	2,150,000	50	52	..
Preferred	2,150,000	50	103	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	88½	89
St. Paul Gas Light Co.	1,500,000	100	50	52
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	80	82
St. Joseph Gas Co	1,000,000	100	..	..
" 1st Mtg. 5's	750,000	1,000	..	..
Syracuse, N. Y.	1,750,000	100	13	15
Bonds	1,612 000	1,000	85	89
Washington, D. C	2,600,000	20	250	..
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	85½	86
Bonds, 5's	3,830,500	.	101¾	102½
Wilmington, Del.	550,000		204	206

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The Directors have this day declared a dividend of one (1) per cent. on the preferred stock, payable December 10, 1898, to stockholders of record at the close of business Nov. 30, 1898. Transfer books of the preferred stock will be closed from Dec. 1 to Dec. 10, 1898, both inclusive. Checks will be mailed

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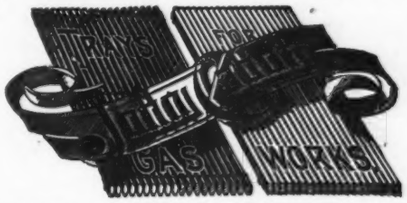

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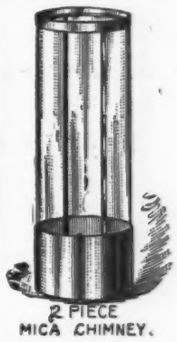

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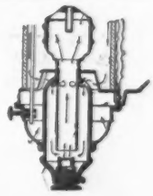

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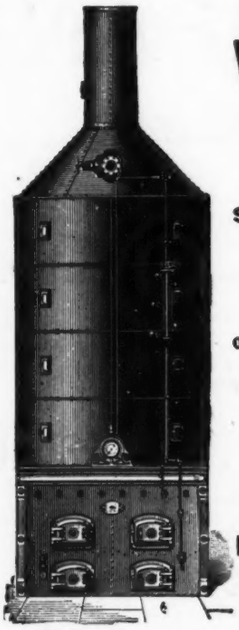

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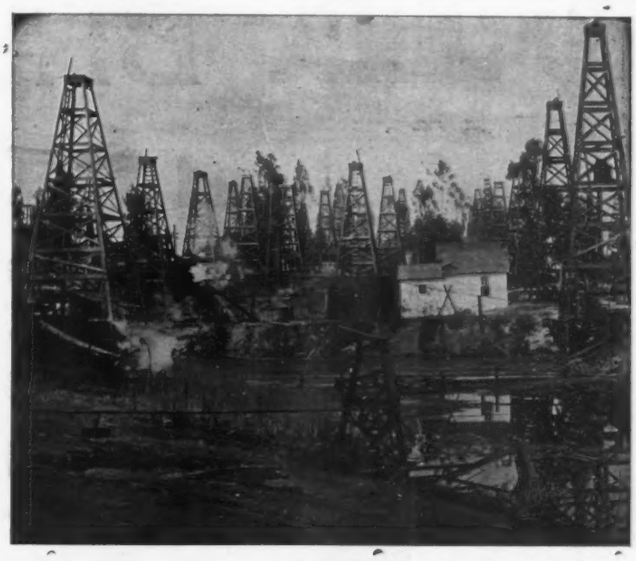

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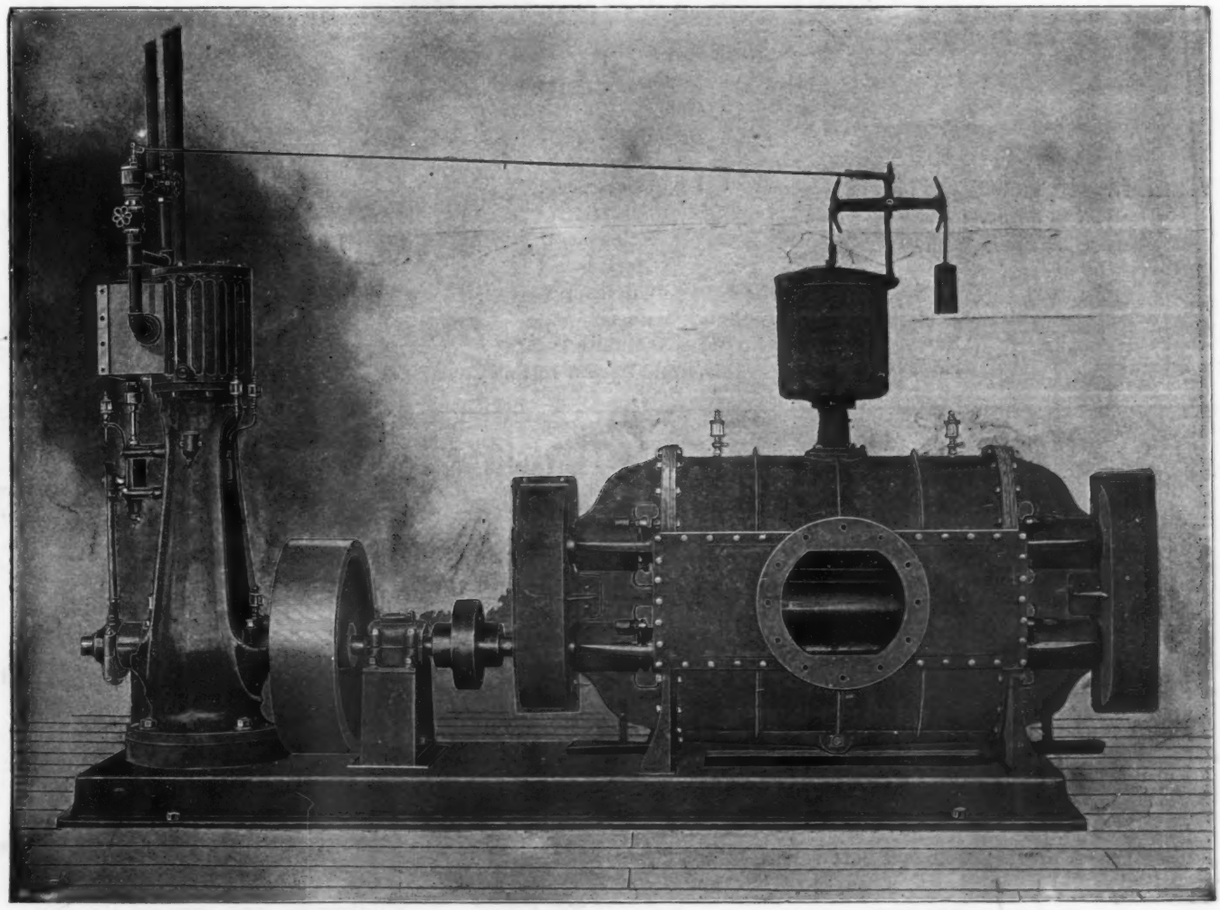

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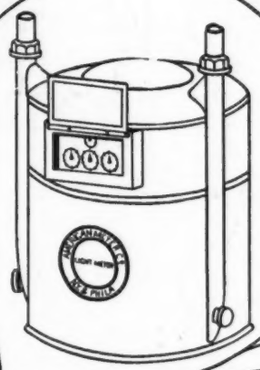

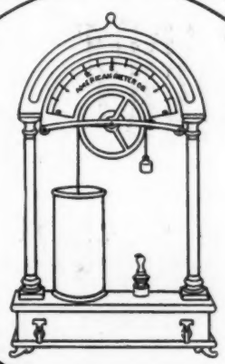

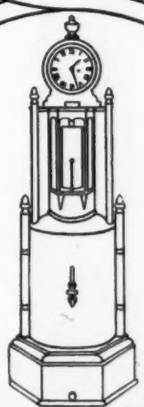

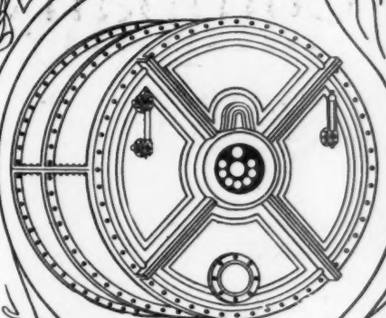

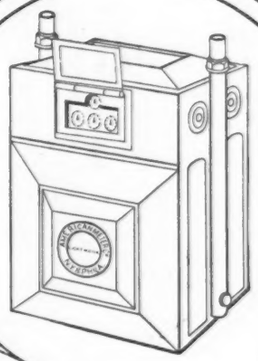

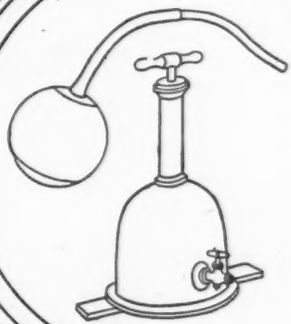

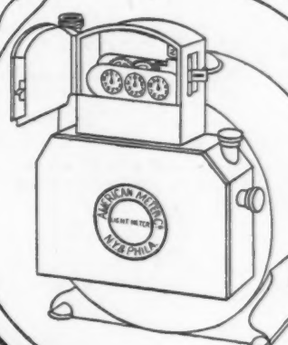

PUBLIC LIGHTING TABLE.

DECEMBER, 1898.

Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light.	Extinguish.
				P.M.	A.M.
Thu.	1	5.10 PM	8.40 PM	4.20	6.10
Fri.	2	5.10	9.40	4.20	6.10
Sat.	3	5.10	10.30	4.20	6.15
Sun.	4	5.00	11.30	4.20	6.15
Mon.	5	5.00 LQ	12.30 AM	4.20	6.15
Tue.	6	5.00	1.30	4.20	6.15
Wed.	7	5.00	2.40	4.20	6.15
Thu.	8	5.00	3.40	4.20	6.15
Fri.	9	5.00	4.50	4.20	6.15
Sat.	10	5.00	6.10	4.20	6.20
Sun.	11	5.10	6.10	4.20	6.20
Mon.	12	5.10	6.10	4.20	6.20
Tue.	13	5.10 NM	6.10	4.20	6.20
Wed.	14	5.10	6.10	4.20	6.20
Thu.	15	5.10	6.10	4.30	6.20
Fri.	16	5.10	6.10	4.20	6.20
Sat.	17	5.10	6.10	4.20	6.20
Sun.	18	10.00	6.20	4.20	6.20
Mon.	19	11.10 FQ	6.20	4.20	6.20
Tue.	20	12.10 AM	6.20	4.20	6.20
Wed.	21	1.20	6.20	4.20	6.20
Thu.	22	2.20	6.20	4.20	6.20
Fri.	23	3.30	6.20	4.20	6.20
Sat.	24	4.30	6.20	4.20	6.25
Sun.	25	5.20	6.20	4.20	6.25
Mon.	26	No L.	No L.	4.20	6.25
Tue.	27	No L. FM	No L.	4.20	6.25
Wed.	28	No L.	No L.	4.20	6.25
Thu.	29	5.10 PM	7.30 PM	4.20	6.25
Fri.	30	5.10	8.30	4.20	6.25
Sat.	31	5.10	9.30	4.20	6.25

TOTAL HOURS LIGHTING DURING 1898.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	210.40	January	423.20
February	186.40	February	355.25
March	181.20	March	355.35
April	166.10	April	298.50
May	156.40	May	264.50
June	144.30	June	234.25
July	147.30	July	243.45
August	157.10	August	280.25
September	169.50	September	321.15
October	186.00	October	374.30
November	204.30	November	401.40
December	218.30	December	433.45
Total, yr.	2129.30	Total, yr.	3987.45

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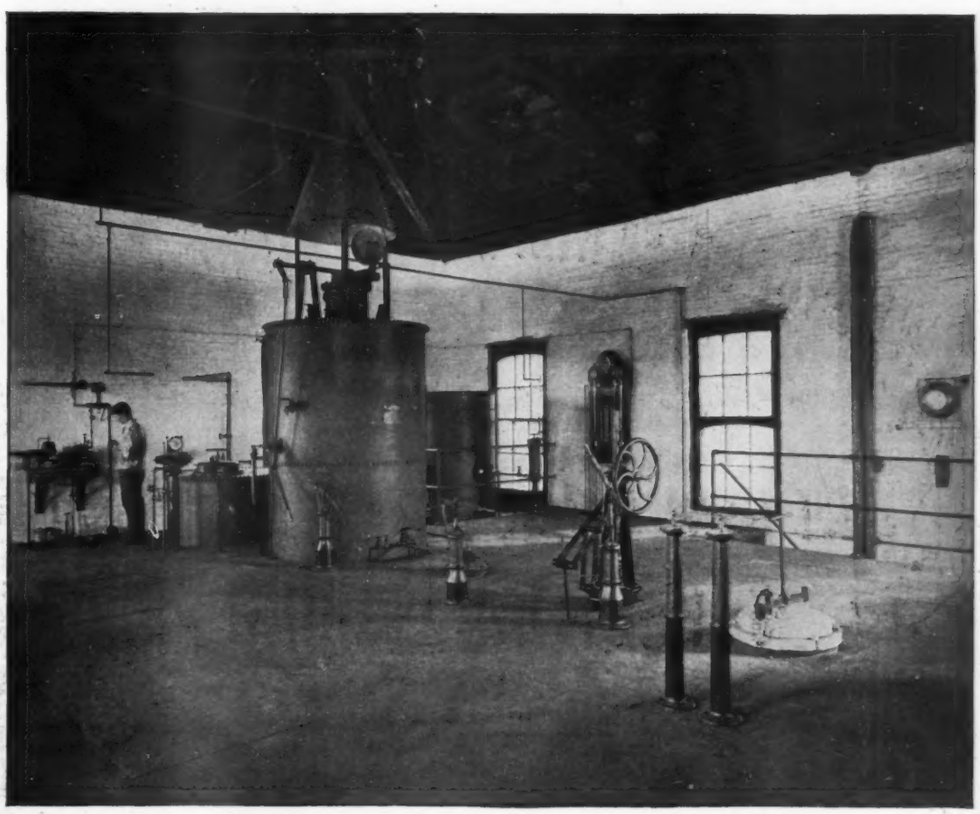

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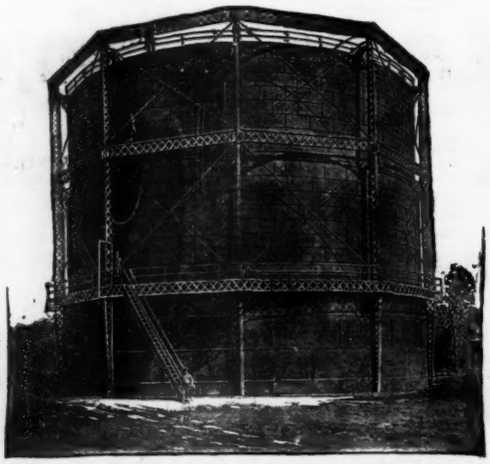

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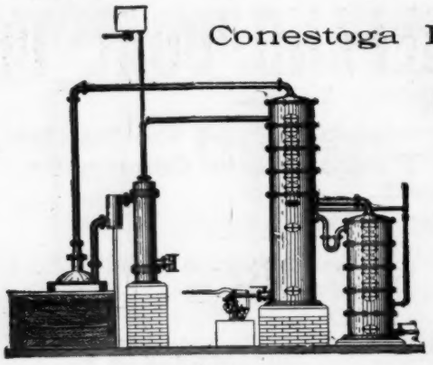

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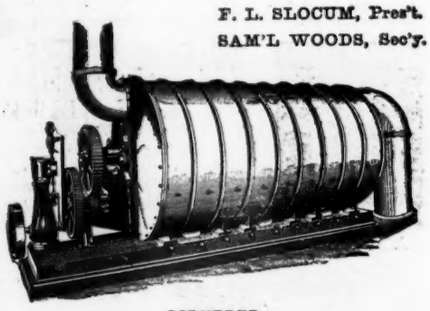

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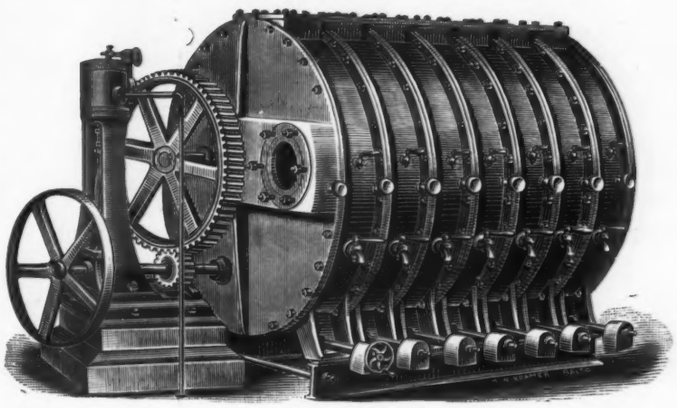

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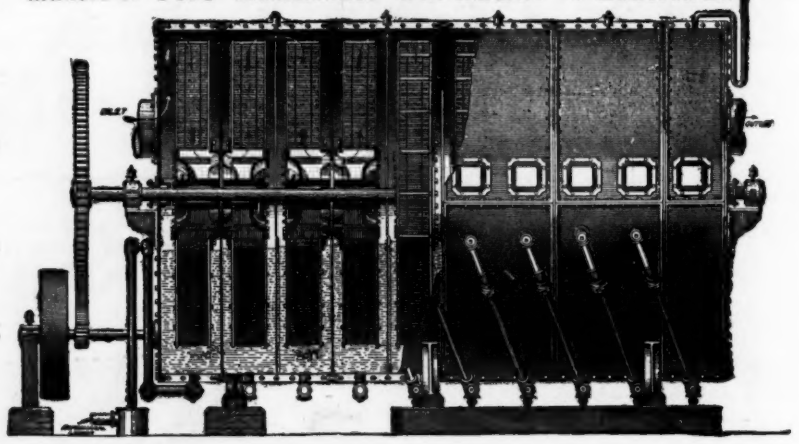

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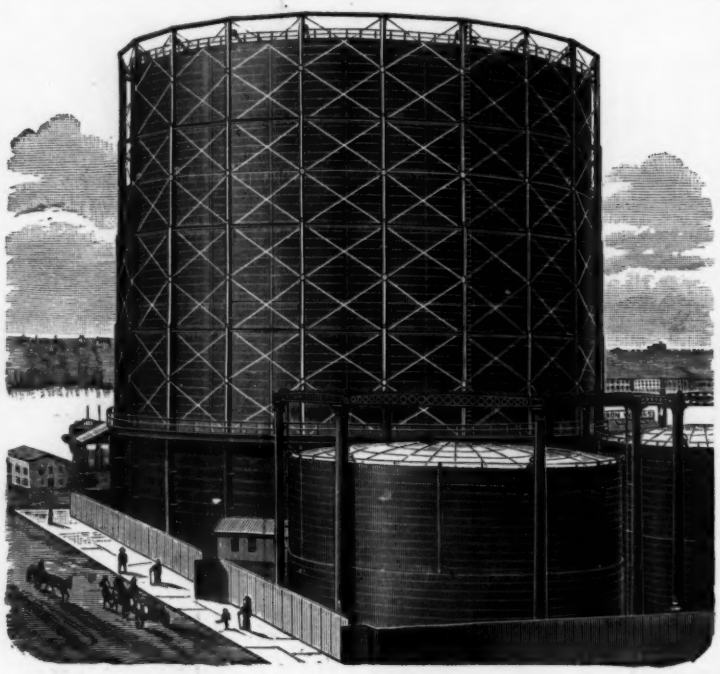

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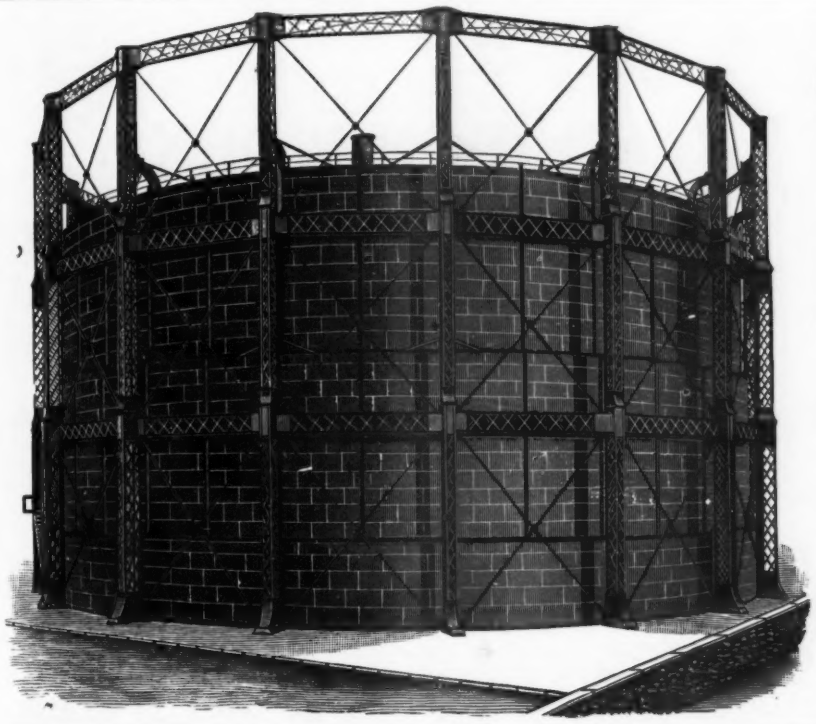

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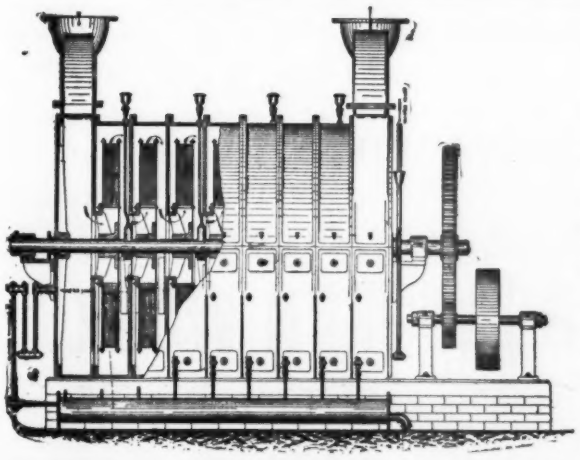

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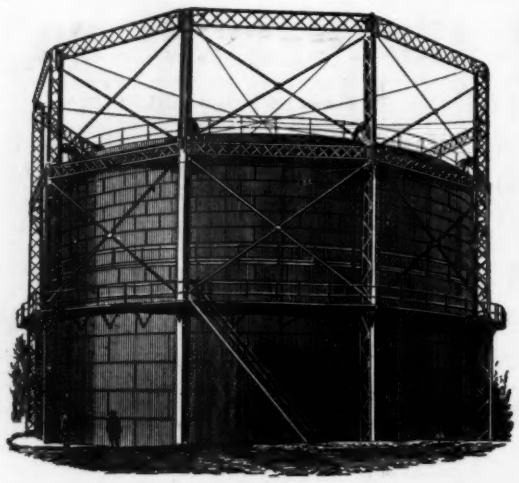

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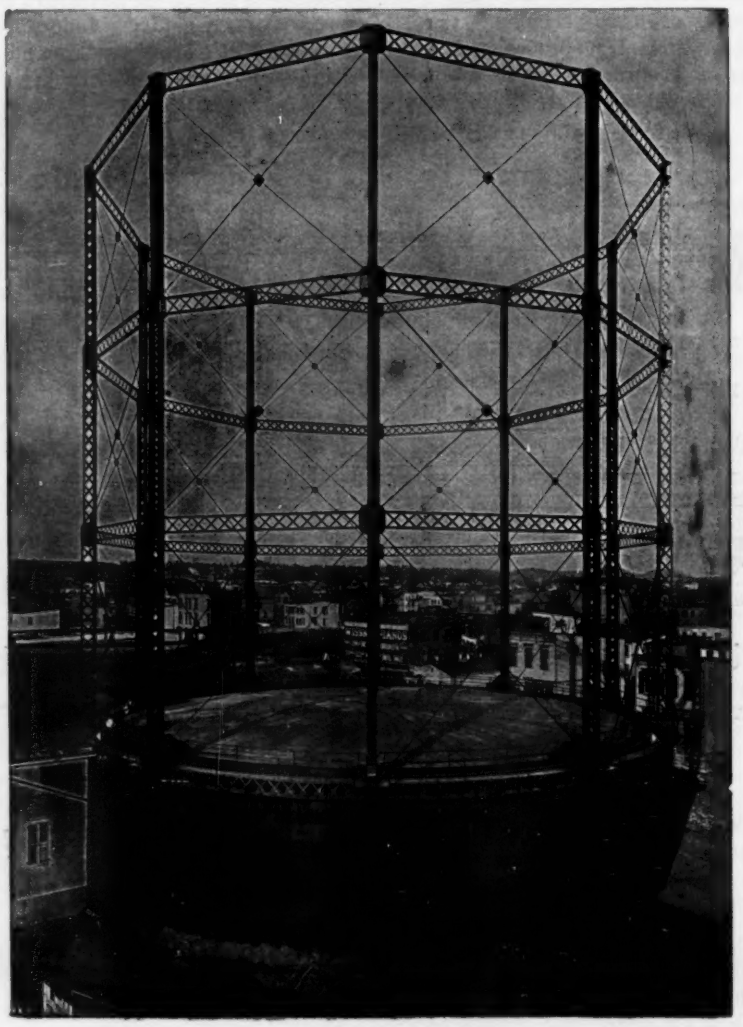

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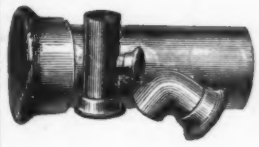

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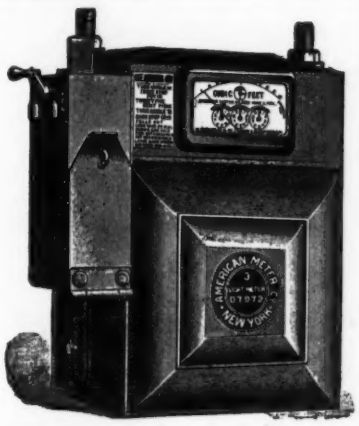

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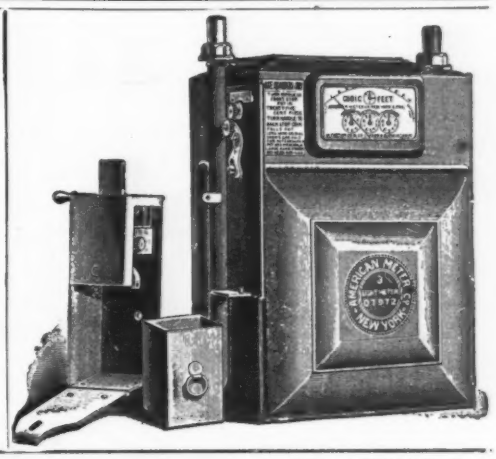

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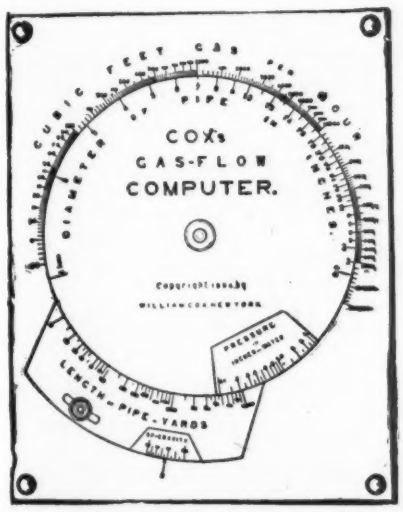

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